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THE RISK OF ANESTHESIA AND SURGICAL OPERATION IN PATIENTS WITH HEART DISEASE

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Section on Cardiovascular Disease

The internist frequently is called upon by his surgical colleagues for an opinion concerning the risk of anesthesia and a surgical procedure in a patient who has organic heart disease. The opinion given must be based on several considerations, for the request carries with it a number of implied questions. The most important of these questions are:

1. Will the anesthesia and surgical operation increase the demands upon the heart beyond the limits of the cardiac reserve and therefore precipitate congestive heart failure?
2. Does the heart require treatment before operation?
3. Is the prognosis of the heart condition so grave that operation should be avoided if possible or limited to an emergency or palliative procedure?
4. Is the heart condition such that it carries with it the liability to sudden death during anesthesia and surgery?
5. What bearing does the state of the heart have on the choice of the anesthetic?
6. What, if any, cardiovascular complications are to be anticipated during the operation and postoperative period?

The information necessary to answer these questions usually can be obtained from the clinical history and physical examination alone without resorting to more elaborate forms of investigation.

It is still quite commonly believed that during anesthesia and surgical operation the heart is subjected to a considerably increased demand for work. There is no evidence, however, that such is actually the case. The two greatest dangers to which a patient is exposed during an operation under general anesthesia are anoxia and shock. If these are avoided by proper anesthesia, minimizing of blood loss, and careful manipulation of tissues, even prolonged and extensive surgical procedures do not increase the load on the heart as much as does moderate physical exertion. Competent anesthesia is seldom attended by cyanosis or more than slight alterations in respiration, pulse rate, or blood pressure; and changes of this kind are encountered no more frequently in patients who have organic heart disease with a satisfactory myocardial reserve than in normal individuals. It therefore may be taken as a rule with few exceptions that patients with organic heart disease who have been able to

carry on normal daily activities without experiencing symptoms of myocardial or coronary insufficiency can tolerate general anesthesia and surgery with no more risk than a normal person.

In estimating the risk of anesthesia and surgery in a patient who has heart disease, careful inquiry as to the occurrence of dyspnea or substernal pain on effort is of much more importance than are the cardiac findings on physical examination. Certain findings, however, such as cardiac enlargement, murmurs indicative of valvular damage, gallop rhythm, and important disturbances of cardiac rhythm, may make it advisable to requestion the patient in order to be certain that the questions have been understood and truthfully answered. The same consideration applies to the great majority of electrocardiographic abnormalities. With few exceptions, an abnormal electrocardiogram in an individual who has been able to carry on normal daily activities without cardiovascular symptoms does not indicate an increased risk from anesthesia and surgery.

Patients with organic heart disease who present symptoms and signs of myocardial failure offer a more difficult problem. In this group, a period of preoperative treatment is advisable, and the intensity and duration of treatment will be determined by the degree of failure and the urgency of the surgical condition. A surgical emergency, such as acute appendicitis or a perforated gastric or duodenal ulcer, will allow no delay, and the risk of immediate operation must be accepted. If congestive failure is present in such a patient, and the patient has not been receiving digitalis, it is best to administer ouabain or a suitable digitalis preparation by intravenous injection before beginning the anesthesia. If ouabain is employed the initial dose usually is 0.5 mg. Additional injections of 0.1 to 0.25 mg. may be given at intervals of four hours after the operation until a total of not more than 1 mg. has been administered. If there is no need for great hurry in obtaining the maximum therapeutic effect of digitalis, the process of digitalization may be completed after operation by intramuscular administration of one of the preparations designed for this purpose.

In patients who have mild or moderately severe congestive failure and in whom operation can be delayed for a few days, rapid digitalization can be accomplished by oral administration of digitalis or digitoxin. Tablets of digitalis leaf may be given in doses of 0.3 Gm. (4½ grains) every eight hours for three doses or 0.2 Gm. (3 grains) three times a day for two days. If digitoxin is employed, an initial dose of 0.8 mg. followed by 0.4 mg. six or eight hours later is recommended. When one of these schedules has been completed, the decision as to whether or not the maximum therapeutic effect of the drug has been obtained must rest upon the judgment of the observer. Certain patients may require added

amounts of the drug. If auricular fibrillation is present, the ventricular rate furnishes a helpful guide; sufficient digitalis or digitoxin is given to reduce the rate, in the absence of hyperthyroidism, to approximately 70 beats per minute. In patients with hyperthyroidism and auricular fibrillation, however, it frequently is impossible to reduce the rate to below 90 or 100 beats per minute. After digitalization has been accomplished, this state should be maintained by adequate daily amounts of the drug. The presence of pulmonary congestion and peripheral edema calls for strict limitation of the sodium chloride content of the diet and may make it advisable to administer one of the mercurial diuretics. Operation should be postponed, if at all possible, until all evidence of congestive failure has disappeared. If this is done, the patient usually can be expected to tolerate anesthesia and operation satisfactorily, whereas if delay is impossible and adequate treatment cannot be carried out, anesthesia and operation may result in a considerable increase in the degree of failure.

Regardless of the adequacy of the preoperative treatment, patients who have had congestive failure before operation must be watched closely during the period after operation. Postoperative complications, such as pulmonary embolism, atelectasis, pneumonia, and abdominal distention, are not well borne and may be responsible for a return of or an increase in the signs of failure. Postoperative mortality related to these complications is considerably greater in patients who have had congestive failure before operation than it is in normal individuals or in those who have organic heart disease with little or no impairment of myocardial reserve.

Digitalis should also be administered before operation to individuals who do not have congestive heart failure but who have experienced dyspnea on moderate exertion and who present such abnormal findings as enlargement of the heart, evidence of valvular disease, auricular fibrillation, auricular flutter, frequent premature beats, or electrocardiographic changes indicative of ventricular strain or coronary artery disease. Although these patients can be expected to tolerate anesthesia and operation satisfactorily, the added strain of unforeseen postoperative complications may be sufficient to precipitate congestive heart failure. The preoperative use of digitalis will improve the ability of the heart to withstand such added strain so that postoperative mortality in this group should not be significantly greater than in individuals who have a normal myocardial reserve. The amount of the drug given should be sufficient to accomplish theoretical digitalization, while the dosage schedule will be determined by the time available.

Digitalis should usually be administered before operation to patients who have enlargement of the heart due to hypertension, even though

there have been no symptoms of diminished myocardial reserve. This does not imply that congestive heart failure is liable to develop in these patients during anesthesia and operation. The enlarged heart in hypertension, however, is an abnormal heart whose efficiency can be increased by digitalis, and the use of the drug in these patients constitutes an effort to attain the best possible cardiac status before operation. The presence of hypertension without cardiac enlargement does not call for the use of the drug.

There is no evidence that digitalis is of benefit in the preoperative care of elderly patients who do not have a diminished myocardial reserve. Occasionally, however, an elderly individual is encountered who has been experiencing dyspnea on exertion and yet presents no objective evidence of cardiac or pulmonary disease. In such patients, the preoperative use of digitalis appears advisable on the assumption that the dyspnea may well be of cardiac origin, even though no proof is available.

The presence of serious heart disease may influence the surgeon considerably in deciding upon the type of operation to be performed. The average life expectancy, for instance, in patients who recently have had acute coronary thrombosis or who are suffering from angina pectoris or Adams-Stokes seizures is such that only unavoidable operations are performed, and the surgical procedure elected is the simplest one which will accomplish the desired result. As an example, the repair of abdominal or inguinal hernias should be postponed in such patients as long as the condition can be controlled reasonably well by mechanical means. Myomata of the uterus should be treated by radiation and not by surgery. Cholecystostomy is to be preferred to cholecystectomy, and gastroenterostomy to more extensive procedures for intractable peptic ulcer. The aim of the surgeon, in cases of this kind, should be to do as little as possible and still insure the relative comfort of the patient for the remainder of a limited life expectancy.

There are certain heart conditions which, even under normal circumstances, are liable to result in sudden death of the patient. It is important that these conditions be detected because, in their presence, the development of even mild anoxia or shock during an operation may precipitate the changes in cardiac physiology which cause sudden death. The conditions include recent myocardial infarction, angina pectoris, aortic stenosis, syphilitic aortic insufficiency, and complete auriculoventricular block complicated by the Adams-Stokes syndrome. Aortic stenosis and syphilitic aortic insufficiency may have caused no symptoms prior to the operation, while the other conditions will have given rise to characteristic manifestations. In patients who have angina pectoris, aortic stenosis, or syphilitic insufficiency, the most common cause of sudden death appears to be ventricular fibrillation which may or may

not be preceded by a short paroxysm of ventricular tachycardia. The same fatal disturbance in rhythm may occur in patients who have suffered recently from acute myocardial infarction, but in these patients also a reduction in coronary blood flow due to shock resulting from hemorrhage or surgical trauma may precipitate further acute myocardial infarction. In complete auriculoventricular block, sudden death results from permanent ventricular standstill. The risk of anesthesia and surgery in patients who have any of the conditions belonging to this group must be recognized beforehand, and the surgical procedure must be as simple as possible.

Because a skillfully administered anesthetic does not increase the work of the heart to an important degree, the factor of heart disease is seldom of more than secondary significance in determining the choice of the anesthetic agent. The type of operation and the general condition of the patient are of much greater importance. The presence of one of those cardiac conditions which are liable to cause sudden death may make it desirable to proceed as far as possible with local anesthesia. The same conditions weigh heavily against the use of spinal anesthesia whenever the contemplated operation can be performed without greatly added difficulty under some other anesthetic agent. The reason for this is that spinal anesthesia causes a decrease in blood pressure and a consequent reduction in coronary blood flow. This reduction in coronary flow may initiate a fatal arrhythmia in patients who have aortic stenosis, syphilitic aortic insufficiency, angina pectoris, or recent myocardial infarction, and in patients with severe coronary disease it may also be responsible for the development of acute myocardial infarction.

Cardiovascular complications are uncommon during operations skillfully performed under competent anesthesia. Anoxia, shock, and a considerable drop in blood pressure may be responsible, however, for the development of premature beats even in patients who have perfectly normal hearts. When due to anoxia, the arrhythmia frequently can be abolished promptly by the administration of increased amounts of oxygen. In patients who have coronary artery disease, the same factors may precipitate an attack of angina pectoris from which prompt relief usually can be obtained by additional oxygen. Auricular fibrillation develops only rarely during anesthesia, but it occurs as a relatively unimportant postoperative complication in approximately 10 per cent of all patients subjected to thyroidectomy for hyperthyroidism. The arrhythmia in these patients generally begins within the first two or three days after operation and usually lasts for less than forty-eight hours. It seldom requires any special treatment, although it seems advisable to begin gradual digitalization with its onset. One of the serious complications to which patients who have mitral stenosis and auricular fibrillation

are subject is an embolic accident due to dislodgment of a portion of a mural thrombus in the auricles. There is no evidence, however, that an accident of this kind is more likely to occur during anesthesia and operation than at other times.

Summary

Anesthesia and surgical operations do not increase the work load of the heart to an important degree. Patients who have organic heart disease but who have been able to carry on normal daily activities without symptoms referable to the heart can be expected to tolerate anesthesia and operation without difficulty, provided that anoxia and shock are avoided. On the other hand, if there have been symptoms of a diminished myocardial reserve or if congestive heart failure is present, a period of preoperative treatment with rest and digitalis is advisable. The treatment should be as thorough as possible during the interval for which the operation can be safely delayed. With adequate treatment, patients who have had congestive failure can be expected to tolerate anesthesia and surgery without difficulty. Postoperative complications, however, such as pulmonary embolism, atelectasis, pneumonia, and abdominal distention, are not well borne and may be responsible for a return of decompensation.

In patients who have auricular fibrillation with or without congestive failure, digitalis should be given before operation in sufficient amounts to reduce the ventricular rate to a satisfactory level. The drug usually should also be administered before operation to patients who have enlargement of the heart due to hypertension, even though there have been no symptoms of diminished myocardial reserve. There are a few heart conditions which are liable to result in sudden death, and the presence of these calls for special care in preventing anoxia, shock, and a reduction in blood pressure during anesthesia and operation. In patients who have one of these conditions, it is desirable to avoid the use of spinal anesthesia, if possible, because of the effect of this type of anesthesia on systemic blood pressure and coronary blood flow.

THE SYNDROME OF THE AURICULOTEMPORAL NERVE

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Among the several atypical facial pains or pseudoneuralgias there occasionally occurs a peculiar disturbance of the auriculotemporal nerve when this structure becomes involved in parotid abscesses or

fistulae. Since parotid abscess is not an unusual complication of typhus fever and since this disease is endemic in eastern Europe, it is only natural that the first description of the condition was reported from Russia and Poland. Frey,[1] after whom the syndrome is frequently named, reported the first authentic case in 1923, although brief consideration was given to the same disorder by Lipsztat[2] in a Polish journal the year before. In 1931 Fridberg[3] cited three examples of the disease in Russian women from Moscow, all in connection with parotitis complicating typhus.

This singular nerve lesion occurs in the wake of an abscess of the parotid gland, but the symptoms may not develop until several years after the original process has healed. Whenever the patient starts to eat, particularly if the food is hot, spicy, dry, or sour, the cheek over the parotid area turns red, and drops of perspiration appear on it. Occasionally the beads of perspiration are so prominent that they give the impression that a chronic parotid fistula is present and that the moisture is saliva. At the same time a feeling of fullness and flushing on the affected side of the face is experienced, while the mucous membrane of the corresponding buccal cavity feels unusually dry. These phenomena do not usually result from the mere movement of mastication unless there is actually food in the oral cavity. Stimulation of the posterior third of the tongue with a sour substance such as vinegar almost invariably brings on the perverted reactions characteristic of the syndrome.

While the symptoms often appear along with a facial nerve paralysis, they are in no direct way related to a disorder of this nerve. Therefore the appearance of so-called "crocodile tears", which is often encountered in a slowly regenerating Bell's palsy, is not correctly incorporated in the syndrome of the auriculotemporal nerve as has been erroneously suggested in some articles and textbooks. Neither does the irritation of the auriculotemporal nerve described in Costen's syndrome produce any of the features typical of the disease discussed in this paper.

Pain and other sensory disturbances are very common during mastication. The patient frequently complains of a deep boring ache in front of the tragus, which may be referred to the temple, the lower jaw, and the ipsolateral side of the tongue and throat. Blunting of tactile sensation may be found over the entire distribution of the auriculotemporal nerve, especially over the temple, the parotid area, and the entire ramus of the jaw.

Only a nerve which carries somatic sensory, vasodilator, and secretory fibers can be involved in the production of such a bizarre maldistribution of regenerated nerve function as presented in this syndrome. The auriculotemporal nerve is a large branch of the third division of the trigeminal trunk. It emerges to the facial skin area by winding

around the ramus of the jaw and contains different fibers conveying sensory impulses from the skin, vasodilator fibers destined for the subcutaneous blood vessels, and the secretory fibers for both sweat glands and the parotid. Secretory fibers for the sweat glands are derived from the cervical sympathetic system by way of the carotid and middle meningeal artery plexuses, while the parasympathetic salivatory fibers to the parotid join the auriculotemporal trunk by way of the otic ganglion from the ninth nerve. Hence as this nerve enters the substance of the parotid gland its components are of several varied physiologic functions.

It seems probable, as Ford[4] explains, that in any disease of the parotid, particularly when its capsule is damaged, these functionally different categories of nerve fibers are badly disorganized. The result is a misdirection of some of the parasympathetic secretory fibers of the parotid gland. In the opinion of the writer these latter nerve elements escape through the ruptured gland capsule to seek connections with end organs in the skin, such as sweat glands and arterioles. Consequently, when the patient is eating, a volley of nervous impulses passes from the medulla over these parotid fibers, causing sweating and vasodilation instead of normal salivation.

While the parotid "bubo" of typhus is a complete stranger to the average American clinician, the parotitis following abdominal operations for suppurative disease is by no means rare and is quite capable of producing the complete auriculotemporal syndrome. Excision of an occasional mixed tumor of the same gland may result in a garbled regeneration of the auriculotemporal nerve and give rise to the same interesting symptomatology. Instances of both in a large Chicago clinic have been cited by the late Peter Bassoe.[5]

The writer has studied two patients, both of whom presented typical aspects of this syndrome following suppurative parotitis, and both complained of a typical facial pain. It is unique that each arrived with a bag of dry crackers and proceeded to demonstrate his symptoms by eating this particular food because it afforded the best display of his prandial discomforts.

Case 1. A man, aged 42, while travelling as a salesman five years before, had developed an infection in his right foot, which swelled suddenly in alarming fashion and necessitated his removal from a train and hospitalization. Suppurative subcutaneous tissue along the inner aspect of the right ankle and calf was incised several times. He eventually became delirious and was semicomatose for several weeks.

Metastatic parotid abscesses appeared on both sides, but the swelling on the right side was more pronounced and painful. Incision was made, and a salivatory fistula discharged for a period of four months.

Two years after recovery from what was apparently a near-fatal pyemia, the patient began to notice flushing and perspiration on the right cheek while eating.

Sour foods exaggerated the symptoms, as did dry material such as toast and crackers. During mastication he experienced some pain in the region of the right temporomandibular joint. Between meals the patient experienced no abnormal sensation other than an abnormally dry mouth.

Examination of the cranial nerves demonstrated a residual Bell's palsy on the right side. On activating the muscles of facial expression considerable clonic twitching of the zygomaticus and platysma was noted. There was some tenderness on pressure over the right tragus. Tactile sensation was diminished in front of the ear and inside the cheek.

Twenty minutes after the hypodermic injection of atropine sulphate the eating of several dry crackers produced no redness or perspiration over the affected area, clearly indicating that any depressant of parasympathetic function serves to remove the important objective symptoms.

Case 2. A woman, aged 38, presented herself with the history of right parotid abscess and fistula eighteen months previously following an operation for ovarian abscess. The parotid suppuration had developed while she was still in the hospital and was treated by ice applications, sedatives, and analgesics. Despite this the condition became complicated with a fistula and a complete facial paralysis.

Seven months prior to admission she sensed a hot, flushing feeling on the right half of the face, which perspired freely whenever she started eating. Five months later she began to experience paresthesia anterior to the right ear. The mucous membranes on the right side of the mouth felt dry. Because of all this and because of the coexisting facial paralysis the eating of any type of food was so distressing an ordeal that she took to eating only soup and milk-soaked bread as a regular diet. The Bell's palsy made her self-conscious to the point that she lived the life of a recluse.

Examination: The patient had a pronounced right facial paralysis with a positive Bell's eye phenomenon and an almost total immobilization of all facial muscles. On masticating three crackers the right buccal cavity filled with the food, the right cheek bulged, became flushed and very moist, and she drooled saliva from the right angle of the mouth.

Sensory findings are demonstrated in the figure. All other cranial components were normal, although there was some slight hyperesthesia on the right side of the throat and the posterior third of the tongue.

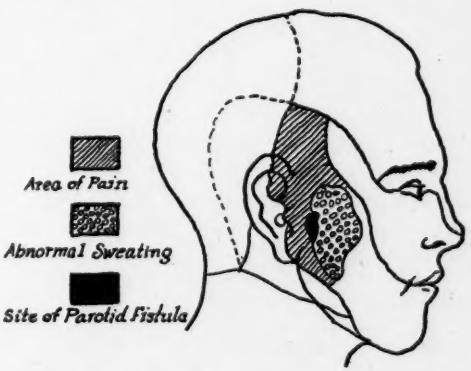

FIGURE. Demonstrating the abnormal secretory and sensory disturbances in the auriculotemporal syndrome following a suppurative parotitis.

Treatment of the syndrome of the auriculotemporal nerve is largely indicated by the assumption that the parasympathetic bulbar centers, by mediating their normal functions into the wrong end organs, are responsible for the perverted reflex behavior. Hence tincture of belladonna administered before meals has a positive relieving value, even though it retards salivation during the act of mastication.

A more radical procedure accidentally achieved good results when a surgeon injected the auriculotemporal nerve with alcohol while attempting to block the facial nerve which he assumed to be responsible for the disorder. Injection of the auriculotemporal nerve is a difficult maneuver. Probably the best technic is to block the entire third trigeminal branch or to inject a perineural effusion of 90 per cent alcohol. Such a relatively heroic measure is only justified if the embarrassments and discomforts associated with mastication of food are poorly tolerated.

REFERENCES

1. Frey, L.: Le syndrome du nerf auriculo-temporal. Rev. neurol. **2**:97-104 (Aug.) 1923.
2. Lipsztat, N.: Neurol. polska, fasc. 6. 1922.
3. Fridberg, D.: Das auriculo-temporale Syndrom. Deutsche Ztschr. f. Nervenh. **121**:225-239. 1931.
4. Ford, F. R.: Paroxysmal lacrimation during eating as sequel of facial palsy (syndrome of crocodile tears); report of 4 cases with possible interpretation and comparison with auriculotemporal syndrome. Arch. Neurol. & Psychiat. **29**:1279-1288 (June) 1933.
5. Bassoe, P.: Auriculotemporal syndrome and other vasomotor disturbances about head. M. Clin. North America **16**:405-412 (Sept.) 1932.

MANAGEMENT OF THE PERMANENT COLOSTOMY

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The term, colostomy, or artificial anus, is of ominous significance to the patient. However, it is interesting to follow the change in his attitude from doubt and depression, through increasing confidence, and finally to personal pride in his ability to manage the artificial opening. As he begins to realize that he can actually lead a normal life despite this handicap, depression is replaced by planning for the future.

Many physicians who refer patients ultimately requiring colostomy to a surgeon see only a few such cases in the ordinary practice of medicine and as a result have little experience in its management. Since these same patients will return with many of their problems to the referring physician, we feel that our experience in dealing with such problems might well be described.

In the past five years we have had the opportunity to follow several hundred patients with permanent colostomies. These patients were interviewed preoperatively, were operated upon at Cleveland Clinic, and were followed postoperatively from six months to ten years. The procedures carried out with all of these patients will be described.

Preoperative Care

The care of this type of patient begins at the time he is first told that an operation will be necessary. Invariably his first question is, "Will I lose the function of my rectum?" To be too brusque and straightforward at this time may be a psychological mistake and lead to much mental anguish. Falsehood and evasion are also unwise and unnecessary. One needs only to reassure the patient that complete extirpation of the tumor with cure of the disease is the primary object of the operation. If this can be accomplished with preservation of the rectum, it most certainly will be preserved. In the event that it is necessary to sacrifice the rectum, the patient can train the artificial anus so that he can lead a normal life. This gives some hope to tide over the shock and offers some confidence in the future. Too often the surgeon considers his work done with the placing of the last stitch. So often the responsibility is then but beginning.

Hospital Discharge Instructions

Colostomy patients are usually discharged from the hospital about the twelfth postoperative day, with the colostomy trimmed flush with the skin of the abdominal wall. They are given sufficient dressings to last six weeks and instructed merely to keep the abdominal wall clean by sponging with warm water and changing the dressings as frequently as necessary. They are to make no attempt at irrigating the bowel and are cautioned not to wear any type of colostomy bag until they return six weeks later for postoperative examination. Patients are advised to use a mild laxative such as milk of magnesia at bedtime if the stool is too constipated but otherwise to allow natural movements to occur. Diet is restricted. The six-week interval allows the bowel to become adherent to the abdominal wall.

Six Week Postoperative Check-Up

The purpose of the six-week check-up is to make sure that healing has occurred and that herniation does not exist, and secondly to give the patient detailed instructions regarding care of the colostomy. Each patient must be individualized. The bowel habits of a patient with a colostomy are no different from those of a normal individual. One person

may normally have a bowel movement twice daily, while another may have one every other day. Since there is no way of knowing beforehand what bowel habit a particular patient may have, a method must be adopted which will cause the least inconvenience to the largest number of patients. With the majority of patients, irrigation every forty-eight hours works most satisfactorily and is less nuisance than if it has to be repeated more frequently. Most patients learn in six months to evacuate the colon every forty-eight hours and leave little leakage between irrigations. Some patients have increased motility of the bowel which requires daily irrigation. Other patients have such a well established bowel habit that they need never irrigate through the colostomy. Patients soon learn which is the best procedure for them, and they should be encouraged to follow it.

The irrigating set sent home with the patient consists of a no. 16 French, male catheter, a rubber disc which fits snugly around the catheter, and a small rubber hose connection. The catheter is introduced into the colostomy for two or three inches or until the tip is below the fascial hiatus. At this point the rubber disc comes in contact with the skin around the colostomy. The disc merely acts as a washer to keep the irrigating fluid from returning from the colostomy. The glass tube rod connects the catheter to the hose of the irrigating can. The patient is advised to use one pint of warm tap water for the irrigation and retain the water for five to ten minutes. The catheter is then removed and the bowel content expelled into a basin held in the lap, or better still, the patient can sit on a small stool to bring the colostomy just above the level of the toilet seat. If the irrigation is not effectual and all of the water has returned, another pint may be used with impunity. The irrigation may be done at the most convenient time of day for the patient but should be done at the same time each day in order to establish a habit. The best time is usually after breakfast. Partaking of the meal starts active peristalsis and thus aids evacuation.

The next problem is what to apply over the colostomy. The colostomy bag or cup is mentioned only to condemn it. It is bulky, inconvenient, malodorous in warm weather, and it invariably produces a hernia or prolapse of the colostomy mucosa by its suction effect. This is a difficult complication to treat but one that seldom occurs if the colostomy bag is avoided. The majority of patients use several thicknesses of soft tissue paper or toilet paper over the colostomy supported by a soft elastic garment or flat belt. Patients should have extra paper available so that in case of an accident they can merely dispose of the soiled paper and replace it with a clean dressing. In men a wide topped athletic supporter is ideal. In women a soft elastic garment works well. Recently we have recommended a flat leather belt manufactured by the Jung Brace

Company of Cincinnati. Patients themselves invent many ingenious devices and methods of more or less value.

Complications

The patient with the new colostomy encounters many problems which cause him much alarm until proper treatment or explanation is forthcoming from the physician. Often slight encouragement and reassurance is all that is necessary. Among these problems are (1) difficulty in irrigation, which may be one of great concern. Until patients are accustomed to the irrigation they may have trouble getting the catheter or the water into the bowel. The water may enter the bowel but not return readily. The irrigation may not be as effectual as desired, as much as expected, or as copious as at the time of previous irrigations. This may cause the patient much anxiety and fear lest the irrigation is not being carried out properly. Relief comes by reassuring him that these are common occurrences, that it will take a few months to establish a bowel habit for the colostomy, and that with perseverance the result will be satisfactory. When constipation occurs a piece of scybalous stool may be caught at the fascial hiatus creating a ball valve effect. Water will enter the colon but will not return readily. A saline cathartic will help break up the constipated stool and permit better irrigation. Sometimes these fecal masses can be broken up digitally. Massage of the abdomen from right to left along the course of the colon may facilitate emptying of the colon. Change in position at the time of irrigation may relieve the constriction of a redundant descending colon or an acute angulation which may be causing poor elimination by partial obstruction.

(2) Bleeding from the colostomy is another cause for much concern. Usually this is only slight in amount and comes from the exposed mucosa. It is important first to make sure that the bleeding is not coming from a polyp or neoplasm higher in the colon. The local bleeding can be controlled by applying a dressing of cold cream or zinc oxide ointment. The patient may then be assured that it is of no serious import and may recur from slight trauma to the mucosa.

(3) Constriction of the colostomy occurs in about 7 per cent of the cases sufficient to warrant reconstruction of the colostomy. The ideal colostomy will admit the tip of the small finger and the stool will be the size of a lead pencil. When the opening becomes smaller it is apt to cause gaseous distention, poor results from the irrigation, and other signs of partial intestinal obstruction. It is much better to have the colostomy small because it is then much easier to manage and also because it is much easier to correct. All colostomies are made in the same way, and it is difficult to explain why 10 per cent should become suffi-

ciently constricted to warrant plastic repair. Postoperative digital dilation may prevent some of the stricture, but this is a rather painful procedure. The constriction is easily corrected by excising the scar around the colostomy and reapproximating the mucosa to the skin.

(4) Prolapse of the colostomy is a rare occurrence. It is a difficult surgical problem and may require resection of the terminal bowel to obtain satisfactory results. In less severe prolapse flat pressure pads may control it adequately.

(5) Attacks of diarrhea may occur and are usually the result of some dietary indiscretion. The patient must carefully eliminate the foods which act as cathartics. In treating the diarrhea paregoric or boiled milk may be used. Boiled milk contains an insoluble protein curd which slows peristalsis and adds bulk to the stool.

(6) Hernia around the colostomy obviously is an anatomic weakness. If the hernia is small it may cause no symptoms and can be controlled by a supportive belt. If it becomes large it may allow the bowel to form a pocket bulge above the fascia which makes evacuation unsatisfactory. Surgical repair is indicated in these cases.

The accompanying chart represents an analysis of 100 cases of combined abdomino-perineal resection of the rectum with permanent colostomy. These cases demonstrate how well the patients control colostomies. All data recorded was received by interrogation of the patient at the time of his postoperative visits. In 76 per cent of the patients good results were obtained by irrigating the colostomy. By good results we mean that they were able to empty the colon at the time of irrigation and have little trouble until the time for the next one. Miles says, "These patients have no control of their colostomy but the colostomy can be controlled." This is true, and except for an occasional soiling which occurs between irrigations, as seen in 66 per cent of the cases, patients are not embarrassed by the passage of gas or stool. The longer the patient has the colostomy usually the less trouble he has. This shows a definite trend toward habit formation of the colon. Dietary indiscretion, emotional excitement, or anything that increases peristalsis will cause accidents. The small percentage of patients who have unsatisfactory results is mostly among those who are chronic complainers or those who make no real effort to establish a colostomy habit.

Among the patients who have learned to live satisfactorily with a colostomy was a school teacher who volunteered that she had missed only two days of school in four years. These patients come from all walks of life and carry on their daily work as usual. One patient stated that he could see no advantage of the normal anus over a colostomy. While this may be somewhat overstated, it is true that most people with a permanent colostomy can live a useful, happy life.

Chart

Operation	All combined abdomino-perineal resection of rectum (100 cases)	
Sex	Female 49	Male 52
Time postoperative	6 months to 10 years	Average 28.7 months
Age	29 to 78 years	Average 52.2 years
Plastic operation secondary to colostomy	6 for stricture	1 for prolapse
Protection cover for colostomy	Elastic belt .....36 Futurd colostomy belt.44 Home made device ... 8 Colostomy bag 2	
Results from irrigations	Good .....76 Fair .....12 Poor..... 4 No irrigations..... 8	
Frequency of irrigations	Every other day .....84 Every day ..... 6 Sporadic ..... 2 No irrigations 8	
Leakage between irrigations	Seldom .....12 Occasionally .....66 Regularly ..... 4 None 18	

OLIVOPONTOCEREBELLAR ATROPHY (HEREDOCEREBELLAR ATAXIA OF MARIE) WITH ENCEPHALOGRAPHIC FINDINGS

Report of a Case

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Hassin and Harris[1] have stated that heredocerebellar ataxia and olivopontocerebellar atrophy is one disease process. This observation was based upon their review of Keiller's[2] work, wherein cerebellar atrophy was observed clinically in 10 members of the same family. The

neuropathologic changes were alike in the cases studied and were typical of olivopontocerebellar atrophy. The outstanding changes noted were: diminished size of the cerebellar folia, atrophy of the olivary bodies and of the pons.

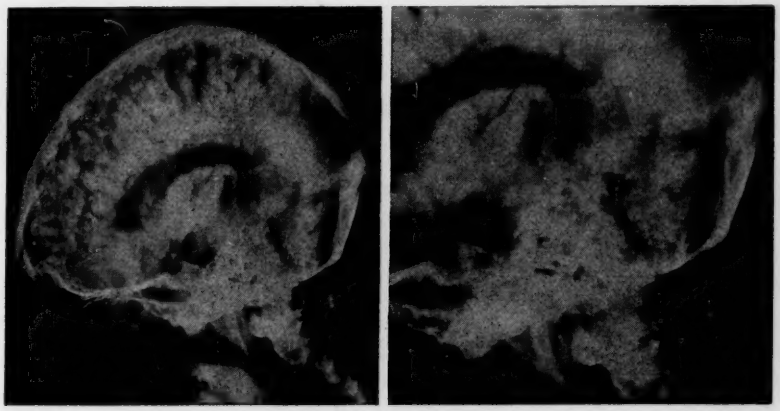
Thus, while olivopontocerebellar atrophy is a pathologic entity, clinically it resembles heredocerebellar ataxia of Marie so closely that it seems to have no definite differentiating features. The presence of a hereditary or familial history of this condition was regarded as the differentiating point between Marie's heredocerebellar ataxia and olivopontocerebellar atrophy. However, these authors feel that olivopontocerebellar atrophy may be both hereditary and familial, having demonstrated that, in the patients with the typical clinical picture of heredocerebellar ataxia, there were also typical pathologic findings of olivopontocerebellar atrophy.

With encephalography it is often possible to determine *in vivo* gross pathologic changes in the brain. At least one of the pathologic changes present in cerebellar atrophy is often gross enough to be detected by encephalographic study. Accordingly, encephalographic study was made of a patient who had the typical clinical picture of heredocerebellar ataxia of Marie (olivopontocerebellar atrophy), and this pathologic change was noted. A lateral view of the encephalogram is presented (figure), while the case report follows.

Case Report

A white man, aged 35, rather stocky and obese, complained of progressive difficulty in walking, talking, using his hands, and in balancing and walking up steps. There had been loss of strength in his legs. He felt that the weakness, uncertainty in walking, and the lack of control was now extending into his fingers and hands. The patient stated that he walked on smooth floors as though he were "walking on slippery ice." He recalled that many years ago he had had to look at the ground to keep his balance while running. An intention tremor had been present for two years. The patient stated that in the last year his speech had changed. "I can't talk fast." There was no dysphagia or bulbar sign. This patient had attacks in which he was unable to move when he awakened in the morning. He recalled a "concussion" which occured when he was kicked in the head while playing football in high school. Herniorraphy was done in 1944. Family history revealed that his maternal grandmother had developed "creeping paralysis" at 65 and died at 67. No details were known.

General physical examination of the patient showed the heart, lungs, and abdomen to be negative, blood pressure 145/100. Examination of the cranial nerves revealed no abnormality. No nystagmus was present. Superficial reflexes were present and equal throughout. Deep reflexes showed marked hyperactivity bilaterally in the lower extremities. No clonus was present. The Babinski response was negative. There was marked ataxic disturbance, slightly greater on the left side. The patient walked with an ataxic gait, throwing his feet forward. There was a questionable loss of pain and temperature sense of the lower extremities to the knees. There was a bilateral loss of position sense and marked pastpointing. Romberg test was mildly positive.



a *b*

FIGURE a. Encephalogram, lateral view: Cortical air increased, particularly in frontal and parietal regions. Ventricular system shows moderate dilatation with no evidence of obstruction. Fourth ventricle is enlarged. Air overlying the cerebellum is considerably increased, giving the appearance of a projection of the occipital lobe over the cerebellar lobe. Cerebellum is markedly decreased in size. Pontine cistern seems enlarged. The distance from floor of the fourth ventricle to anterior surface of the pons suggests some loss of pontine substance. The olives cannot be visualized.

b. Enlargement of a. in the cerebellopontine area, giving greater detail of the described changes.

Blood study showed 13.0 hemoglobin (84 per cent); 9700 leukocytes; blood sugar 105 mg. per cent four and a half hours postprandially; blood Wassermann and Kahn tests negative. Urinalysis was negative. Spinal puncture showed initial pressure 190 mm. of water. Dynamic responses were normal. Five cubic centimeters of clear, colorless cerebrospinal fluid was removed, and final pressure was 110 mm. of water. Examination of the fluid revealed no cells, no globulin, total protein 33 mg., with negative Wassermann, Kahn, and colloidal gold reactions. X-ray examination of the cervical region of spine, normal; skull, normal. There was no evidence of platybasia and nothing suggesting brain tumor. Basal metabolic rate was minus 4.

Encephalogram was performed March 6, 1946, under sodium pentothal anesthesia. Pressure relations were normal. A total of 265 cc. of air was injected, while 255 cc. of fluid was withdrawn. Examination of this fluid was identical to that of the first fluid examined. It was felt that the patient had olivopontocerebellar atrophy (Marie's heredocerebellar ataxia).

Comment

There is presented here the encephalographic picture of a case of olivopontocerebellar atrophy, or Marie's heredocerebellar ataxia. While the history of similar involvement in other members of this family is admittedly weak, the clinical picture is that of Marie's disease. It is believed that the gross changes evident in this encephalographic picture represent in part at least some of the gross changes which are

found in olivopontocerebellar atrophy. There is present in these films evidence of marked cerebral cortical atrophy and a moderate diffuse enlargement of the ventricular shadows.

The presence of convolutional atrophy affecting the frontal and superior temporal lobe was emphasized by Keiller[2] in his studies. That a decrease in cerebral substance and an increase of fluid is present is evident in the amount of fluid removed (255 cc.). The most significant finding, the large collection of air overlying the cerebellum, is apparent. The occipital lobes overlapped the cerebellum, a finding which has been observed rather consistently in postmortem studies. The fourth ventricle is well visualized and appears to be enlarged, thus further emphasizing the marked decrease in size of the cerebellum. While it is in no wise as definite as the cerebellar atrophy, there appears to be an increase in the space representing the pontine cistern area and is suggestive of a diminution in size of the pons. However, this cannot be accurately determined. It is, of course, impossible to identify the olives.

As we stated before, gross changes typical of olivopontocerebellar atrophy are: diminished size of the cerebellum due to atrophy of the white substance of some cerebellar folia, atrophy of the olives and of the pons. In these films it is evident that there is diminished size of the cerebellum, a suggestive decrease in the size of the pons, and an increase in the size of the fourth ventricle; the olives cannot be identified. Thus it is felt that olivopontocerebellar atrophy is the pathologic condition present.

In the original description of this condition by Dejerine and Thomas[3] in 1900 it was stated to be neither a familial nor a hereditary condition. It is now generally accepted that Marie's hereditary cerebellar ataxia and olivopontocerebellar atrophy are one and the same disease. Accordingly, it appears that this case fits into such classification. Roentgenographic studies of the less common neurologic conditions are of interest to those concerned with correlations between the clinical findings and the encephalographic changes found. It is with this thought in mind that this case has been presented.

Summary

1. A case of olivopontocerebellar atrophy (heredocerebellar ataxia of Marie) is presented with encephalographic findings which are believed to be consistent with the gross pathologic changes generally found at postmortem examination.

2. The changes observed were a marked cerebellar and cerebral cortical atrophy, moderate ventricular dilatation, and probable decrease in the size of the pons.

REFERENCES

1. Hassin, G. B., and Harris, T. H.: Olivopontocerebellar atrophy. Arch. Neurol. & Psychiat. 35:43-63 (Jan.) 1936.
2. Keiller, W.: Four cases of olivopontocerebellar atrophy, giving history of heredity with three autopsies. South. M. J. 19:518-522 (July) 1926.
3. Dejerine, J., and Thomas, A: L'atrophie olivo-ponto-cerebelleuse. N. iconog. de la Salpêtriere, Par. 13:330-370. 1900.

SPASTICITY: PHYSIOLOGIC AND NEUROSURGICAL CONSIDERATIONS WITH PRELIMINARY REPORT OF TWO CASES

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Spasticity is a condition of the musculature identified by partial or complete paralysis and increased resistance to movement associated with hyperactivity of the reflexes of the tendon and periosteum. The control of discharges going out over "the final common pathway" to produce normal muscle tone is a fine adjustment of many descending impulses arriving at the anterior horn cell, a summation of those from the cortex, basal ganglia, reticular substance, tegmentum, and cerebellum. In the surgical treatment of spasticity four distinct methods have been utilized: excision of the cerebral cortex, resections at lenticular level, cordotomy, and resection of the spinal nerve roots. This paper will discuss these procedures and present the results in two cases treated by cordotomy.

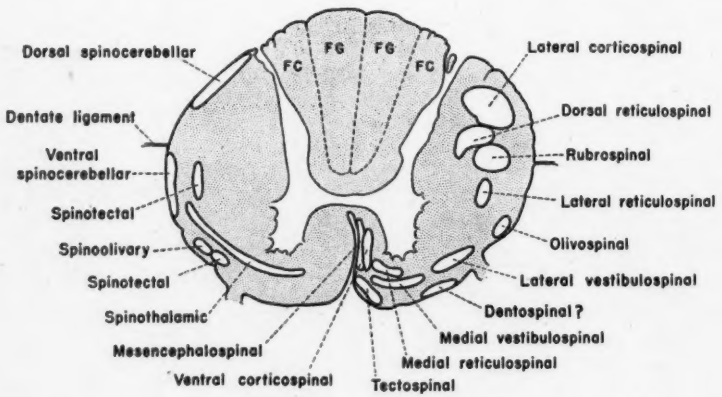
Knowledge of the pathologic process that brings about spasticity is far from complete. It has been shown that changes in muscle tonus can be produced by lesions in cortical areas 4, 6, and 4s, as well as in certain portions of the basal ganglia, reticular substance, tegmentum, cerebellum, and spinal cord.

Physiologically there is a wide diversity of opinion as to the mechanism producing spasticity. In the opinion of the authors it appears advisable to consider that increase in tonus is not always due to a release phenomenon but often to a predominance of one group of descending pyramidal and extrapyramidal impulses over another, or as Magoun has phrased it, "spasticity results from combined disturbances of extrapyramidal innervation." Hence, when attempting surgically to alter the tonus of muscle groups, we must consider all the descending impulses impinging on the anterior horn cell, the inhibitory as well as the excitatory (Bodian, Magoun, Hines, Murphy and Gellhorn).

The next consideration is the anatomic location of the extrapyramidal and pyramidal tracts. Putnam has postulated that there are two groups of descending extrapyramidal pathways. The first "lies just anterior to the crossed pyramidal tract, and extends mesially as far as the gray matter." The second "lies along the periphery of the cord in the anterior quadrant." We are including a semi-diagramatic chart of the well established and also controversial pathways (figure). Of these we feel that the reticulospinal tracts, a possible direct cerebellar, and a portion of the rubrospinal tract are the most important efferent pathways, while the ventral spinocerebellar is the most important afferent. To date, Papez' work on cats is probably the best available complete work on the origin of these pathways.

Bodian has recently shown that extensive neuron destruction occurs in the reticular formation of the lower brain stem in cases of acute poliomyelitis in monkeys which were sacrificed shortly after the appearance of generalized spasticity. He postulated that destruction of the inhibitory mechanism located there "was at least in part responsible for the spasticity of poliomyelitis", adding corroboration to Magoun's suggestion that spasticity was largely dependent on injury to the pathways arising in cortical area 4s and extending to the reticulospinal centers in the brain stem.

With this evidence in mind it seems safe to assume that one of the reticulospinal tracts acts to decrease muscle tone. The influence of the cerebellar nuclei has been discussed (Kleist, Bonhoeffer, Snider and Stowell, Delmas-Marsalet and van Bogaert), but the pathways over which the descending cerebellar impulses travel to produce "discrete"



Spinal Cord Segment T II

movements are not known. The situation is undoubtedly much more complicated than even our present knowledge indicates, especially when we consider the part played by "the diffuse mechanism of conduction known to exist in the gray matter of the spinal cord" (Rasmussen).

We believe it advisable to include the spasticity of acute poliomyelitis and spinal cord lesions, along with the three most common types of spasticity: hemiplegia, paralysis agitans, and the athetoid-dystonic group. In these syndromes there is a common denominator of increased muscle tone, although the amount of paresis and hyperkinesia and hypokinesia is variable.

Conservative methods of therapy directed at alleviating the disorders of spasticity have in general proved disappointing. Muscle reeducation has been the basis of treatment in cerebral palsies (Phelps, Carlson). Curare (West, Burman) and more recently prostigmine (Kabat and Jones, Eveleth and Ryan) have helped materially in lessening the tone of spastic muscles and also in decreasing the amplitude and frequency of muscle spasms. With recent physiologic advances and improved surgical technics, however, interest has been growing in the attempt to alter the tonus of muscle by operative procedures. The report of Scarff and Pool on the advantages of posterior column resections in flexor spasms is the most recent.

The first surgical procedure to relieve spasticity was performed in 1909 by Sir Victor Horsley, who excised the motor cortex successfully for the relief of athetosis. The removal of cortical areas was repeated with beneficial results by David and Hecaen, Sachs, Bucy and Buchanan, Bucy and Case, and Klemme. Unsuccessful operations were listed by White, Foerster, Browder, and Davison and Goodhart. Klemme's series is by far the largest, and many of his cases were benefited when measured by the effect on the hyperkinetic phenomena. Mashanskiy, Nasaroff, and Naffziger injected alcohol into the motor and premotor areas with variable results.

Russell Myers introduced a second approach at the lenticular level. He first removed a portion of the caudate nucleus and later revised his operation to interrupt the pallidofugal fibres. He obtained good results in abolishing the tremors and rigidity of paralysis agitans.

The posterior roots were sectioned for tremor by Foerster and Gagel, and Pollack and Davis, and the posterior columns by Rizzatti and Moreno, and Scarff and Pool. In Scarff and Pool's report the results were excellent in alleviating spasms.

In 1931 Putnam first divided the anterolateral columns for athetosis, and this procedure was subsequently repeated by Oldberg, Mashanskiy, and Toennies. Putnam later cut the lateral pyramidal tracts in cases of

paralysis agitans with successful results. In one of Putnam's cases of anterolateral column resection there was partial relief of rigidity.

Lesions produced in the dentate nucleus reduced the rigidity of paralysis agitans but increased the tremors (Delmas-Marsalet and van Bogaert). The effect of sympathectomy will be discussed in a later paper.

Case Reports

Case 1. A white man, aged 24, was admitted to Cleveland Clinic Hospital complaining of weakness in the legs of four years' duration. The present illness had started gradually with loss of power in the right foot. With the progressive weakness there were associated involuntary movements and stiffness of both lower extremities. The patient had had a kyphosis and scoliosis for many years.

Neurologic examination demonstrated that the patient was unable to walk without support. The cranial nerves showed no abnormalities, and sensation and motor power of the upper extremities were normal. The legs were extremely spastic, and extensor and flexor spasms were precipitated by a minimal stimulus. There was hypalgesia of stocking type over the legs and feet.

Myelogram was carried out, revealing a partial block at the upper margin of the second thoracic vertebra. Laminectomy revealed rotation of the cord with apparent stretching. A diagnosis of congenital scoliosis with cord compression was made.

Cordotomy was then performed at the second thoracic dermatome, and the left anterolateral column was divided, the cord being resected for a depth of 4 mm. from the dentate ligament ventrally to a point 0.5 cm. anterior to the exit of the motor roots. Following operation the patient had less spasticity and fewer muscular spasms in the left leg. There was no involvement of the pathways subserving bladder function, and there was analgesia to the fifth thoracic dermatome on the right. The patient had an uneventful postoperative course and was discharged to return in three months for resection of the right anterolateral column.

The first case was admitted to the hospital on account of severe flexor and extensor spasms of both extremities. Prostigmine by mouth, intramuscularly, and intrathecally had offered only transient incomplete relief. There was improvement (approximately 30 to 50 per cent) in the spasms and spasticity after the cordotomy.

Case 2. A woman, aged 25, was referred to the Clinic on February 7, 1946, by Dr. Paul B. Stewart of Warren, Pa., complaining of severe pain in both legs and thighs. The patient had started to use a walker at the age of 8 and had never been able to walk normally. A diagnosis of spasticity due to cerebral birth injury was made. In March, 1945, she had started to have attacks of "drawing of the legs" which were associated with severe pain requiring large doses of opiates. She had been confined to bed. A fasciotomy produced no relief, and the patient as a last resort was referred to the hospital for cordotomy.

The patient presented the typical picture of dystonia affecting the head, arms, and legs. She was unable to walk. The head had an irregular tremor or jerking when she talked or became excited. The arms had athetoid movements, greater on the right than on the left, which were increased by effort or emotion. The legs presented an amazing picture, both being "drawn-up under her" in extreme flexion. During periods of excitement or while the patient was lying comfortably there were flexion spasms involving the biceps muscle group of the thighs and the gastrocnemius-soleus group of the legs, and

she would grimace with pain. Sensation was normal, and all reflexes were hyperactive with Babinski reflexes present bilaterally. Both knee joints were almost fixed. Laboratory studies revealed Escherichia coli cystitis. The patient had control of bowel and bladder.

Curare intravenously gave no relief, and therefore an anterolateral cordotomy was performed on the right side at the second thoracic dermatome. The scalpel was inserted 5.0 mm. just anterior to the dentate ligament and carried forward and laterally to section the anterolateral column, the blade being withdrawn at the exit of the anterior roots.

Following operation there was relief of pain in both legs. The spasticity and flexor spasms had completely disappeared in the right leg, and the left leg was analgesic.

Three months later the patient had no pain in either leg and stated that she was able to move the right foot better than the left. Examination five months later showed that the tonus of the right leg was definitely less than the left.

This case represented one of the athetoid-dystonic group. The patient had been referred mainly because of severe pain in both lower extremities, greater in the left leg. Right anterolateral cordotomy was carried out to relieve the pain of the left leg, and it was hoped that by sectioning the ventral spinocerebellar and one of the reticulospinal and descending cerebellar pathways, the spasticity of the homolateral leg would be alleviated. Following operation the patient was entirely free from pain in the right leg due to complete relief of the spasticity and flexor spasms and in the left leg due to analgesia.

Evidence has been presented that neurosurgical procedure directed against spasticity will become of greater and greater benefit as our knowledge of the anatomy, physiology, chemistry, and pathology of the nervous system increases, and will be of distinct advantage in supplementing the pharmacologic and the physiotherapeutic approach. No conclusions can be drawn from the cases reported, but they suggest that cordotomy can favorably influence spasticity.

Bibliography

1. Bodian, D.: Experimental evidence on the cerebral origin of muscle spasticity in acute poliomyelitis. Proc. Soc. Exp. Biol. M. **61**:170-175 (Feb.) 1946.
2. Bonhoeffer, K.: Ein Beitrag zur localization der choreatischen Bewegungen. Monatsch. f. Psychiat. u. Neurol. **1**:6. 1897.
3. Browder, J.: Modification of spastic hemiplegia by cortical excision. J. Nerv. & Ment. Dis. **97**:692-694 (June) 1943.
4. Bucy, P. C., and Buchanan, D. N.: Athetosis. Brain **55**:479-492 (Dec.) 1932.
5. Bucy, P. C., and Case, T. J.: Athetosis: Surgical treatment of unilateral athetosis. Arch. Neurol. & Psychiat. **37**:983-1020 (May) 1937.
6. Bucy, P. C., and Case, T. J.: Tremor: physiologic mechanism and abolition by surgical means. Arch. Neurol. & Psychiat. **41**:721-746 (April) 1939.
7. Burman, M. S.: Therapeutic use of curare and erythroidine hydrochloride for spastic and dystonic states. Arch. Neurol. & Psychiat. **41**:307-327 (Feb.) 1939.
8. Carlson, E. R.: Infantile cerebral palsy: its treatment by selective inhibition of sensory stimuli. Ann. Int. Med. **11**:324-334 (Aug.) 1937.
9. David, M., and Hecaen, H.: Neurosurgical treatment of dyskinesia (choreoathetoid movements, dystonia, tremor). Semaine d. hôp. de Paris **22**:209-219. 1946.
10. Davison, C., and Goodhart, S. P.: Dystonia musculorum deformans: clinicopathologic study. Arch. Neurol. & Psychiat. **39**:939-972 (May) 1938.

11. Delmas-Marsalet, P., and Van Bogaert, L.: Sur un cas de myoclonies rhythmiques continues déterminées par une intervention chirurgicale sur le tronc cérébral. Rev. Neurol. **64**:728-740 (Nov.) 1935.
12. Eveleth, M. S., and Ryan, A. J.: Prostigmine in acute anterior poliomyelitis. Yale J. Biol. & Med. **17**:351-357 (Dec.) 1944.
13. Foerster, O.: Schlaffe und Spatische Lahmung. Handbuch der normalen und pathologischen Physiologie. (Berlin: Julius Springer, 1929) p.922.
14. Foerster, O.: Zur Analyse und Pathophysiologie der striaren Bewegungstorüngen. Ztschr. f. d. ges. Neurol. u. Psychiat. **73**:1. 1921.
15. Foerster, O., and Gagel, O.: Die Vorderseitenstrangdurchschneidung biem Menchen: Ein klinisch-patho-physiologisch-anatomische Studie. Ztschr. f. d. ges. Neurol. u. Psychiat. **138**:1-92. 1932.
16. Frazier, C. H.: Surgery of the Spine and Spinal Cord. (New York: D. Appleton & Co., 1918). p. 668.
17. Fulton, J. F.: Physiology of the Nervous System. (New York: Oxford Univ. Press, 1938).
18. Gray, L. P.: Experimental evidence on connections of vestibular mechanism in cat. J. Comp. Neurol. **41**:319-364 (Aug.) 1926.
19. Hines, M: "Motor" cortex. Bull. Johns Hopkins Hosp. **60**:313-366 (May) 1937.
20. Horsley, V: The function of the so-called motor area of the brain. Brit. Med. J. **2**:125. 1909.
21. Kabat, H., and Jones, C. W.: Studies on neuromuscular dysfunction. Neostigmine therapy of chronic spastic paralysis from cerebral lesions. J. Nerv. and Ment. Dis. **103**:107-129 (Feb.) 1946.
22. Kleist, K.: Die Psychomotorischen Störungen und ihr Verhältnis zu den Motilitätstorungen bei Erkrankungen der Stammganglien. Monatschr. f. Psychiat. u. Neurol. **52**:254. 1922.
23. Klemme, R. M.: Surgical treatment of dystonia, with report of 100 cases. A. Research Nerv. & Ment. Dis. Proc. (1940) **21**:596-601. 1942.
24. Krieg, W. J. S.: Functional Neuroanatomy. (Philadelphia: The Blakiston Co., 1942).
25. Magoun, H. W.: Recent contributions to extrapyramidal system. Q. Bull. Northwest. Univ. M. School. **20**:180-191. 1946.
26. Magoun, H. W., and Rhines, R.: Inhibitory mechanism in bulbar reticular formation. J. Neurophysiol. **9**:165-171 (May) 1946.
27. Mashanskiy, F. I.: Anterior chordotomy in grave forms of athetosis. Sovet. khir. **10**:672-680. 1936.
28. Idem: Traitement chirurgical des mouvements involuntaires des extremitiés applique au parkinsonisme post-encéphalique. J. de Chir. **46**:877-899 (Dec.) 1935.
29. Meyers, R.: Present status of surgical procedures directed against extrapyramidal diseases. New York State J. Med. **42**:535-543 (Mar. 15) 1942.
30. Idem: Surgical interruption of pallidofugal fibers; its effect on syndrome of paralysis agitans and technical considerations in its application. New York State J. Med. **42**:317-325 (Feb. 15) 1942.
31. Murphy, J. P., and Gellhorn, E.: Influence of hypothalamic stimulation on cortically induced movements and on action potentials of cortex. J. Neurophysiol. **8**:341-364 (Nov.) 1945.
32. Naffziger, H. C., cited by Bucy, P. C., and Case, T. J.: Athetosis: surgical treatment of unilateral athetosis. Arch. Neurol. & Psychiat. **37**:983-1020 (May) 1937.
33. Nasaroff, N. N.: Über Alkoholinjektionen in die kortikale Hirnsubstanz bei Athetose. Zentralbl. f. Chir. **54**:1478-1481 (June 11) 1927.
34. Oldberg, E., cited by Putnam, T. J.: Diagnosis and treatment of athetosis and dystonia. J. Bone and Joint Surg. **21**:948-957 (Oct.) 1939.
35. Papez, J. W.: Comparative Neurology. (New York: Thomas Y. Crowell Co., 1929).
36. Idem: Summary of fibre connections of basal ganglia with each other and other portions of brain. A. Research Nerv. & Ment. Dis. Proc. (1940) **21**:21-68, 1942.
37. Phelps, W. M.: Care and treatment of cerebral palsies. J.A.M.A. **111**:1-6 (July 2) 1938.

38. Idem: Symposium on orthopedic surgery: treatment of cerebral palsies. Clinics **2**:981-991 (Dec.) 1943.
39. Pollack, L. J., and Davis, L.: Muscle tone in parkinsonian states. Arch. Neurol. and Path. **23**:303-319 (Feb.) 1930.
40. Putnam, T. J.: Alternating tremor (paralysis agitans) and athetosis; recent advances in diagnosis and treatment. New England J. Med. **222**:473-476 (Mar. 21) 1940.
41. Idem: Diagnosis and treatment of athetosis and dystonia. J. Bone and Joint Surg. **21**:948-957 (Oct.) 1939.
42. Idem: Relief from unilateral paralysis agitans by section of the pyramidal tract. Arch. Neurol. and Psychiat. **40**:1049-1051 (Nov.) 1938.
43. Idem: Results of treatment of athetosis by section of the extrapyramidal tract in spinal cord. Arch. Neurol. and Psychiat. **39**:258-275 (Feb.) 1938.
44. Idem: Treatment of athetosis and dystonia by section of extrapyramidal motor tracts. Arch. Neurol. and Psychiat. **29**:504-521 (Mar.) 1933.
45. Idem: Treatment of unilateral paralysis agitans by section of lateral pyramidal tracts. Arch. Neurol. and Psychiat. **44**:950-976 (Nov.) 1940.
46. Rasmussen, A. T.: The Principal Nervous Pathways. (New York: The Macmillan Co., 1945).
47. Rizzatti, E., and Moreno, G.: Cordotomia laterale posteriore nella cura delle ipertonie extrapiramidali postencefalitiche. Schizofrenie. **5**:117-122 (Jan.-June) 1936.
48. Sachs, E.: Subpial resection of cortex in treatment of Jacksonian epilepsy (Horsely operation) with observations on areas 4 and 6. Brain **58**:492-503 (Dec.) 1935.
49. Scarff, J. E., and Pool, J. L.: Factors causing massive spasm following transection of the cord in man. J. Neurosurgery **3**:285-293 (July) 1946.
50. Snider, R. S., and Stowell, A.: A comparison of the tactile areas in the cerebellum of the cat and monkey (Macaca mulatta) Anat. Rec. **94**:498 (Mar.) 1946. (Discussion).
51. Spiegel, E. cited by Putnam, T. J.: Treatment of athetosis and dystonia by section of extrapyramidal motor tracts. Arch. Neurol. and Psychiat. **29**:504-521 (March) 1933.
52. Toennies, J. F., cited by Putnam, T. J.: Diagnosis and treatment of athetosis and dystonia. J. Bone and Joint Surg. **21**:948-957 (Oct.) 1939.
53. West, R.: Pharmacology and therapeutics of curare and its constituents. Proc. Roy. Soc. Med. **28**:565-578 (March) 1935.
54. White, J. C.: Experience with extensive resections of the premotor cortex for athetosis and Parkinsonian Tremors (Klemme's operation). J. Nerv. & Ment. Dis. **94**:204-205 (Aug.) 1941.
55. Winslow, R., and Spear, I. J.: Section of posterior spinal nerve roots for relief of gastric crises and athetoid and choreiform movements. J.A.M.A. **57**:238-240. 1912.

TREATMENT OF CEREBRAL PALSY

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In 1862, Little[1] described a group of children suffering from spastic paralysis. Most of them were thought to be hopeless idiots, although it appeared worthy of mention that some of the children showed evidence of normal intelligence. The possibility of treatment was not considered.

Since that time, however, many patients have benefited by treatment for cerebral palsy.

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The aim in treatment is not the same as in other diseases in which the physician attempts to cure the patient. In cerebral palsy the aim is to help the patient, but in very few cases is complete normalcy obtained. Some patients can be taught self help such as feeding and dressing, which may be their only barriers to independence. This independence having been established, several normal persons, formerly in constant attendance on the patient, may be freed for more profitable work.

Because of its nature, several types of specialists are interested in this disease. The neurologist, the orthopedist, the internist, the pediatrician, and the physiatrist* all find aspects of such cases coinciding with their respective fields. Interesting possibilities of treatment are offered by the neurosurgeon,[2] and others may add to the knowledge of the condition.

The physiatrist maintains close association with agencies and therapists such as social service and speech therapists, physical therapists, and occupational therapists, and is therefore in a position to coordinate treatment of the patient. Easy access to these fields is almost essential to the management of cerebral palsy, as is the opportunity to consult with other medical specialists in questionable cases.

The importance of the problem of cerebral palsy is indicated by the frequency of its occurrence. According to various statistics it is estimated that in a city of a million there are between five and eight hundred treatable patients under the age of 20.[3] The number of treatable cases represents only a little over one-half the total number of children born with the disease.

Diagnosis Imperative in Treatment

Recognition of cerebral palsy is frequently an easy task. The differential diagnosis of the types, however, is more complicated. For the purpose of treatment cerebral palsy is divided into three major types: (1) spastic, (2) athetoid, and (3) ataxic.

In the spastic type the child suffers from loss of nervous tissue in the motor areas of the brain or in the tracts leading from those areas. The resulting clinical picture is muscle imbalance. Individual muscles may be spastic, flaccid, normal, tight, or weak. There has been much written on the anatomic basis of these neuro-muscular defects. The essential factor is realization that they may all occur in the same patient in any combination, and that recognition of the spastic type depends upon the finding of a stretch reflex in some of the involved muscles. This sign is

*At its last annual meeting the Council on Physical Medicine voted to sponsor the term "physiatrist" as the designation for the physician specializing in Physical Medicine. J.A.M.A. 131:34 (May 4) 1946.

pathognomonic of this type of cerebral palsy. Other neurologic evidences of the spastic type are absence of skin reflexes and a positive Babinski sign, indicating defects in the pyramidal system.

Cerebral palsy of the athetoid type is frequently mistaken for spastic paralysis because of the presence of reflex muscular tension by which the patient attempts to eliminate excessive motion. This phenomenon may easily be taken for the spastic stretch reflex. It is most essential that these types be distinguished because of the great difference in treatment of the two. The classical case of cerebral palsy of the athetoid variety is characterized by tremor, choreiform, or athetoid movements, which may be general or localized. The absence of stretch reflexes, the ability of the examiner to shake the tension out of a part, and the absence of pathologic reflexes, indicating pyramidal tract lesions, all aid in establishing a diagnosis of athetosis.

The spastic and the athetoid groups comprise about 80 per cent of cerebral palsy incidence.[4] Part of the remaining cases are of the ataxic type, the balance consisting of mixed types. Ataxia is usually attributed to lesions in the cerebellum or its efferent tracts. The ataxia may be general, as is the usual case, or localized. It is identified by the patient's inability to orient himself in space without visual aids.

Plan of Classification and Treatment

There are various technics by which a plan of treatment can be formulated. Most workers believe that a definite plan should be established when the patient is first seen. At the Cleveland Rehabilitation Center we attempt to accomplish this in the following manner. The patient is admitted to the Center on the recommendation of any private physician or clinic, the diagnosis usually being made before the patient comes to our attention. However, in many cases, the exact type of cerebral palsy is left for us to determine. Upon the first examination an attempt is made to establish a specific diagnosis, but if there is any doubt this can be delayed and the patient put on a two-week trial of intensive treatment and observation. During this time the therapists can observe the patient and assemble valuable data which are helpful in establishing a definite diagnosis as to the type of cerebral palsy present and the mental ability of the child as well as the actual physical handicap.

At the end of the two-week period the case is again reviewed by the physiatrist in a conference with the therapists, psychologist, and medical social worker. After this review it may be necessary to have psychologic testing to estimate the child's level of intelligence or referral for audiometric testing and refraction to further aid in diagnosis and determination of treatability. Orders are given for physical therapy, speech ther-

apy, and occupational therapy, the specific orders decided according to the child's greatest need. This plan is flexible and may be revised at recheck examinations, which are made every six to eight weeks. Surgical procedures, splints, and braces are included in the general plan of treatment at this time.

Treatment

Spasticity is a condition involving individual muscles, rendering them spastic, flaccid, weak, normal, or tight. Thus, any treatment of this type of cerebral palsy must be based on a careful evaluation of the relative power of the muscles and their antagonist. Orthopedic technics employed for this type are: neurectomy, tendon lengthening, tendon transplant, arthrodesis, splinting, and bracing. Such technics are employed only after careful evaluation of the antagonist muscles. Under the direction of a physical therapist and/or an occupational therapist, the patent can then be taught to utilize to best advantage his new balance in power.

Athetosis presents the problem of involuntary motion. Muscle weakness in the athetoid type is thought to result from disuse or tension. In this type of cerebral palsy peripheral surgery is seldom if ever indicated. Braces may enable the athetoid patient to control involuntary motion, but their use should be accompanied by intensive treatment in conscious relaxation by physical and/or occupational therapy. Recent advances in neurosurgery[2] may offer additional means of future treatment for this type.

Treatment of the ataxic type of cerebral palsy consists for the most part in training the patient to substitute conscious balance control for the automatic balance control which he has lost. The ataxic patient is dependent on visual sensations for orientation. Braces and appliances are of no value in training. Training should be given by physical and occupational therapy.

The treatability of the various types of the disease depends upon intelligence of the patient, severity of the involvement, and associated defects such as speech, hearing, and sight, which may limit the patient's ability to express himself. These handicaps must be taken into consideration in the original evaluation of the case, and special technics in training must be employed to overcome them. The speech therapist is frequently called upon to assist with the diagnosis as well as to manage treatment of the language defect. This may include audiometric testing, since hearing loss is an important factor in some speech defects. Likewise, corrective lenses must be used to correct visual defects if indicated.

Drugs have been used in the treatment of cerebral palsy for many years. Phelps[3] has recently discussed the effects of hyoscine, prostigmine,

dilantin, phenobarbital, and curare in the management of the disease. Of these drugs dilantin is of proved value in cases with associated epilepsy, and prostigmine shows considerable promise because of its ability to reduce spasticity and control athetosis, thereby rendering the patient more adaptable for training. It should be emphasized that drug therapy is in no way a substitute for planned programs of training by means of physical therapy, occupational therapy, and speech therapy.

Summary

1. Recent interest in cerebral palsy has made us cognizant of the extent of the problem and the importance of modern methods of treatment.

2. The importance of coordination of the various specialties and services concerned with the diagnosis and treatment has been emphasized.

3. The physiatrist, due to his particular training and close association with other specialized fields and services, is in an advantageous position to coordinate treatment.

4. The diagnosis and the importance of differentiation between spastic, athetoid, and ataxic types of cerebral palsy have been briefly discussed.

5. A method of comprehensive planning and several fundamental technics of treatment have been outlined.

References

1. Little, W. J.: On the influence of abnormal parturition, difficult labours, premature birth, and asphyxia neonatorum, on the mental and physical condition of the child, especially in relation to deformities. Transactions of the Obstetrical Society of London **3**:293-344, 1861.
2. Stowell, A., and Gardner, W. J.: Spasticity: physiologic and neurosurgical considerations with preliminary report of two cases. Cleveland Clin. Quart. October, 1946.
3. Phelps, W. M.: Recent significant trends in the care of cerebral palsy. South. Med. J. **39**: 132-138 (Feb.) 1946.
4. Phelps, W. M.: Recent trends in cerebral palsy. Arch. Phys. Therapy **23**:332-336 (June) 1942.

OCCUPATIONAL THERAPY IN THE TREATMENT OF CONGENITAL ATHETOSIS

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Congenital athetosis presents many problems that are best solved by occupational therapy technics. The athetoid child is handicapped not by the loss of motor nerves, as in the spastic type, but by excess purposeless movements superimposed upon the voluntary patterns. In addition he usually develops an increased tension in fixing muscles in an attempt to stop excess motion. The basic motor patterns are frequently present. There may be a deficiency in the patterns which is usually learned by trial and error because the child finds experimentation difficult. The child may become discouraged and stop attempting movements. He may develop such abnormal patterns that some muscles become abnormally strong and others weak from disuse.

Occupational therapy attacks the problem in three different ways. It presents a psychological stimulus, interesting the child in his own improvement; it provides exercises for strengthening weakened muscles; it teaches the child self help and expression within his capacity.

Training of the athetoid is based on the principle that coordinated movement can be accomplished only for the relaxed state. The child is taught conscious relaxation followed by coordinated movement. He learns the principles in physical therapy and puts them into practice in occupational therapy. It is necessary, therefore, that these two be closely coordinated in the over-all treatment plan for the patient. In consultation with the physiatrist, the occupational therapist learns which part of the treatment she is to cover and how it fits into the entire plan for the patient.

One of the most satisfactory ways to produce psychological stimulation is through a pre-school group socialization program. At the Cleveland Rehabilitation Center the children are divided into two groups, depending on the severity of their handicaps. Here the child sees other similarly handicapped children making an attempt to do what is asked. Here, away from his parents frequently for the first time, he has companions of his own age and learns to get along with the other children while at the same time he is learning from them. Such a program, supplemented by special individual work of the occupational therapist with

games and toys designed to stimulate a desire to participate, is the first step in treatment of the pre-school athetoid.

In planning the training of the athetoid child, all daily activities must be broken down into their component parts according to joint motions. Thus the therapist can determine which part of the total pattern is preventing the child from normal completion of the activity. In feeding training, for example, the therapist may observe poor shoulder control. Even a fairly good hand is of little use when the shoulder is so poorly coordinated that the hand cannot be placed where it will be used to advantage. In such a case the therapist devises some activity requiring gross motion of the shoulder for the purpose of teaching control. Whenever possible the training is started proximally. Actual feeding training with food is usually begun with the child seated before a mirror and at a table which is cut out to permit support of the elbows. Equipment may be adapted in a number of ways, for example with handles of spoons bent or built up. The aim in any adaptation is to use the special equipment only until the patient can progress to equipment less modified from normal. The same sort of plan and technics are used by the occupational therapist to teach drinking and dressing.

As soon as the child is ready for school he must be taught some method of expressing himself on paper. This may be of first importance in children with language defects. The selection of writing or typing will depend in part on the degree of involvement. Motor handicaps and mental handicaps must be distinguished. Complete disorganization of motor control may be present in a child with normal intelligence. In very severe cases, if one-finger typing can be taught with special equipment, the child may be accepted for school. In less involved cases such training may enable the child to make better progress when he is admitted to school.

Graphs are frequently used to record progress during training. They serve a dual purpose: (1) they give the physician the quantitative information he desires in a concise form, and (2) they provide incentive for the patient. Graphs for these children are set up so that progress is represented by an ascending line.

Throughout the time that the patient is receiving occupational therapy for his physical condition he is also receiving a more subtle phase of treatment in incidental encouragement or suggestion.

We realize that complete recovery of athetoid children can never be expected. Our problem during treatment is to help the patient make an adjustment to his handicap. He must realize that there are many things that he can do well and many things that are not within the physical limitations imposed by his disability. By careful selection of activity and by substitution of things which he can do well for those in which

he cannot compete, occupational therapy lays the groundwork for more satisfactory vocational adjustment at a later date.

Occupational therapy of this type must be carefully planned and coordinated with physical therapy and speech therapy. Treatment, either by the occupational therapist or at home with frequent check-ups by the physician and therapist, must be continued for a number of years. Providing there is normal or nearly normal intelligence and there is cooperation from the home, the child with minimal to moderately severe handicaps may be expected to show progressive objective improvement during the period of growth. By progressing from simple tasks, such as feeding, drinking, and dressing, to self expression and vocational training the otherwise useless individual may be able to make his contribution to society.

Bibliography

1. Carlson, E. R.: Educational and vocational aspects of the problem of the cerebral palsied. J. Rehabil. **12**:24. 1946.
2. Martin, E. F.: Occupational therapy treatment for cerebral palsies at Children's Rehabilitation Institute. Occup. Therapy **19**:331-338 (Oct.) 1940.
3. Phelps, W. M.: Differential characteristics of spasticity and athetosis in relation to therapeutic measures. New York State J. Med. **41**:1827-1831 (Sept. 15) 1941.

PULMONARY MANIFESTATIONS OF BRUCELLOSIS

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Pulmonary brucellosis has received scant attention, although it has long been known that all three types of brucellosis may attack any body tissue. As early as 1861, in discussing Malta fever, Marston[1] wrote: "There is no fever so irregular in its course and symptoms." Craig[2] in 1906 said: "It is extremely difficult to describe accurately all the forms which this truly protean disease may assume." The largest number of autopsies in brucellosis have been reported by Hughes.[3] He frequently noted pleural adhesions, pleural effusion, and patchy or lobular consolidation. Others have more recently reported pulmonary involvement. Bogart[4] described massive bronchopneumonic infiltration due to both acute and chronic inflammation. Beatty[5] thinks the most common pulmonary manifestation is hilar and bronchovascular infiltration and reported 12 patients showing this finding. Hemoptysis with tracheal ulceration,[5,6] infiltration and consolidation,[6,7,8,9,10,11,12] unresolved pneumonia,[6] lung abscess,[9] and pleural effusion[9] have been recorded by others. Hardy[9] once recovered the Brucella from pleural fluid by guinea

pig inoculation. Debono[9] found positive blood cultures in patients with lung involvement.

The following group of patients is reported to illustrate various types of pulmonary diseases observed in the study of several hundred patients with brucellosis at Cleveland Clinic. Most patients had a chronic type of infection.

Case 1. A white man, aged 48, entered Cleveland Clinic May 10, 1938, with a dry, hacking cough and substernal discomfort of five weeks' duration. There was also a history of headaches, chills, fever, drenching sweats, and loss of 23 pounds of weight. His temperature was recorded as high as 102° and the pulse rate 110. The chest was clear to physical examination and to x-ray. Agglutination for brucellosis was positive, 1:2560. This patient responded remarkably to sulphanilamide and has been previously reported by one of us.[14]

Case 2. A white woman, aged 25, entered Cleveland Clinic May 22, 1946, with persistent hoarseness, cough, and fever of several months' duration.

During the preceding year she had suffered in succession with a chondritis of the nose, acute hepatitis with jaundice, arthritic involvement of the spine and ankles,

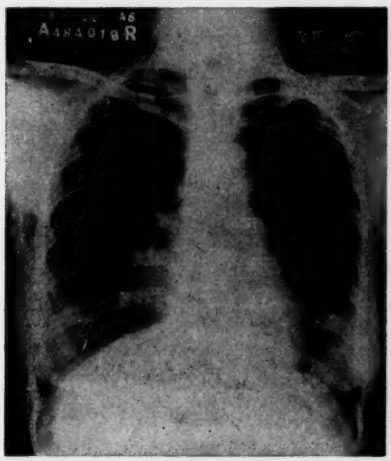


FIG. 1. Case 2. Hilar and bronchovascular infiltration in right lung.

and recurrent pharyngitis. She had had fever as high as 104° and lost 25 pounds of weight. There was a further history of chondritis of the left ear in 1943 and of the right ear in 1942.

The only positive physical findings were a pulse rate of 120, temperature 99.0°, harshness of breath sounds at the hilar areas, husky voice, and diffuse edema of the entire larynx with fullness or piling up of tissue in both ventricles.

The reddish elevation on the superior surface of each vocal cord was stripped off laterally to the ventricles. Sections of this material showed edema and hyperemia of subendothelial stroma with moderate lymphocytic infiltration beneath a normal

epithelium. A chest film at this time revealed prominent hilar and bronchovascular markings in the right lung (fig. 1). A bronchogram was negative. Brucella agglutination was negative, but an intradermal test proved strongly positive. The patient returned to the Clinic on July 18 with a right orbital cellulitis and a chondritis of the left ear, which followed her first two injections of Brucella vaccine. The hoarseness had cleared, and the blood agglutination was still negative.

Case 3. A white boy, aged 14, came to Cleveland Clinic Hospital May 13, 1931, because of persistent fever and stiffness in the muscles. His illness had begun in February, 1930, with fever, malaise, and stiffness in the joints. He had developed a patchy skin eruption resembling urticaria. There had been pain and swelling in the testes for a time. Fever had been as high as 104°. He had had severe sweats. Six weeks after the onset of illness he had developed a pleural effusion. Ten cc. of fluid had been aspirated from the left side and reinjected into the subcutaneous tissues. After two to three weeks the effusion disappeared, and he was improved until March, 1931, at which time fever returned with muscular stiffness but no joint pains.

When he was examined two months later there were no significant physical findings in the heart or lungs. There was slight nystagmus, slight digital tremor, and slight ankle clonus with normal reflexes. A chest film revealed very shallow costophrenic angles. The temperature was as high as 104° and the pulse rate 150. Agglutination for brucellosis was positive, 1:80, and an intradermal test gave a markedly positive reaction. The patient had improved under a course of specific vaccine but relapsed in March, 1932, with high fever, swollen and painful breasts, and an audible friction rub over the lower right side of the chest. He was given brucellin and apparently had a good result. However, the breasts remained prominent.

He was seen again in 1940 complaining of fatigability, grating in the neck with aching pain in the left shoulder, back of head, and neck. In 1944 he had another febrile relapse accompanied by an erythema multiforme-like eruption similar to that of his original illness. He likewise had episodes of fever in December, 1945, and in May, 1946. Each of these relapses was accompanied by pain and swelling in the breasts and appeared to respond to sulphonamides. He was last seen July 30, 1946, and still had some grating and soreness of the neck. The breasts were hypertrophied and the testes small but firm.

A chest film showed the same obliteration of costophrenic angles as in 1931. The blood agglutination was negative, and other tests were reported negative during the intervening years. The remains of another strongly positive intradermal test, done several months previously, were clearly visible on his arm.

Case 4. A white girl, aged 15, was first seen at Cleveland Clinic on January 12, 1932, with acute mastoiditis without a bulging drum or middle ear discharge. The leukocyte count was only 2000 with 35 per cent granulocytes. There was, in addition, a history of three and a half years of ill health characterized by weakness, nervousness, tachycardia, and headaches with cough, postnasal discharge, and occasional fever during the past year. A tonsillectomy had been performed in July, 1931. For a month before her initial visit she had had a hard cough with foul greenish sputum and temperature of 100° to 103° each afternoon, accompanied by chilliness and sweats. The ear symptoms were of only two days' duration.

At examination coarse rales and a few wheezes were audible in both lungs, most marked over the right base. There was definite mastoid tenderness on the left. X-ray examination revealed some nontuberculous infiltration in the base of the right lung. Blood culture and agglutination for brucellosis were both negative.

At mastoidectomy, bone cells were found to be filled with a thick purulent material having the appearance of an acute process superimposed on an old chronic infection. Convalescence was uneventful, but the temperature again became elevated after the

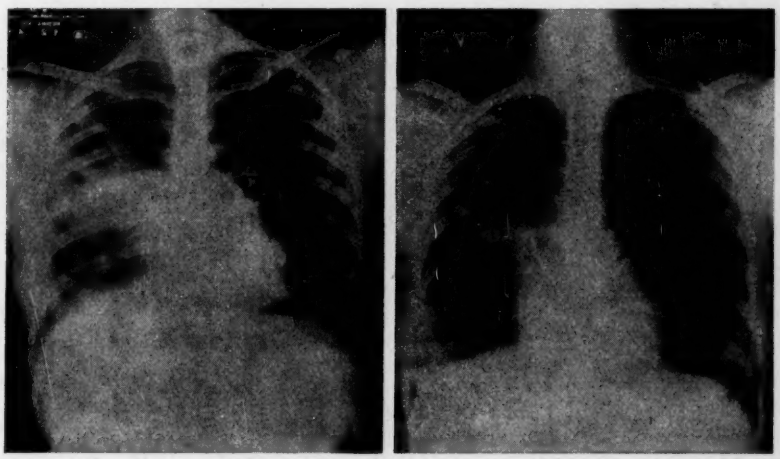
patient returned home, and her cough and headache continued. She began to have fever associated with each menstrual period, and on May 24, 1932, agglutination for brucellosis was positive, 1:80. By August, 1932, an abscess had developed in the mid right lung. No definite pathogen could be cultured. She was treated with repeated artificial pneumothoraces, and by January, 1934, the abscess had entirely healed. Meanwhile other agglutinations were positive in a titer as high as 1:360. Fever and headache continued with no evidence of increased intracranial pressure. She had several abscessed teeth and at one time complained of blurred vision with the finding of definite neuroretinitis. She was treated with Brucella vaccine and was apparently greatly improved but later had a recurrence of fever that was not helped by vaccine. She continued to have fever and headaches and on November 30, 1934, her leukocyte count was only 1400.

It is of interest to note that in 1932 and 1933, seven cows belonging to the family were condemned because of Bang's disease.

The patient died elsewhere December 10, 1934, with a clinical diagnosis of peritonitis. Necropsy findings were reported as generalized peritonitis, chronic pleurisy, and terminal pneumonia. There was no examination of the skull, and no cultures were reported.

Case 5. A white woman, aged 24, came to Cleveland Clinic February 28, 1946, because of recurring hemoptysis during the preceding ten days. In the fall of 1944 she had had a respiratory infection that was diagnosed pneumonia. X-ray examination at that time showed a lesion suggestive of tuberculosis, but a patch test and the sputum were negative. Dyspnea and a productive cough persisted, and she complained of bouts of pleuritic pain over the diaphragm and costovertebral angle. She had gained from 25 to 30 pounds since the onset of illness.

Examination of the chest was negative, and during a week's observation her highest temperature was 99.6°. The chest film was entirely comparable to one made elsewhere a year earlier and revealed a somewhat rounded, not definitely marginated area of in-



a *b*

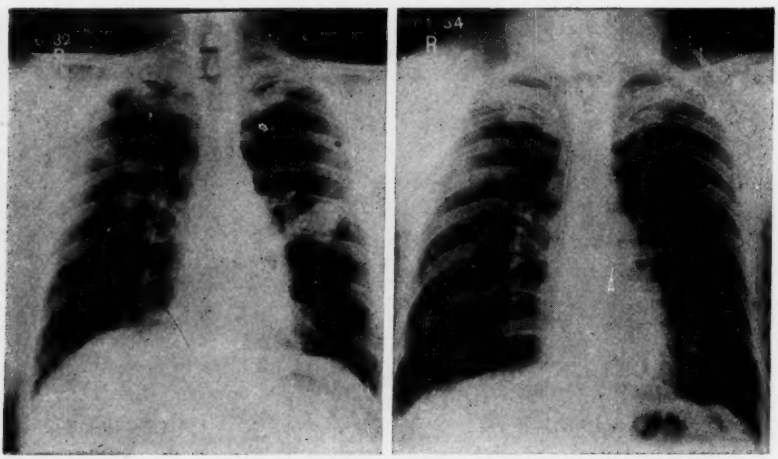
FIG. 2. Case 5. (a) Pneumonic infiltration of six months' duration (4-12-45) in right lung (b) clearing gradually after twenty-two months (8-13-46).

creased density extending outward several inches from the right upper hilus. It was impossible to identify a neoplasm bronchoscopically. A small amount of purulent mucus came from the orifice of the right upper lobe bronchus. Culture of this material showed streptococci, and the sputum was again negative for acid-fast bacilli. A small amount of bloody fluid was aspirated by needle puncture from the area of the lesion, and its culture was sterile. This patient had a negative agglutination for brucellosis but a strongly positive intradermal test. A course of penicillin was given. When last seen August 13, she appeared entirely well; the agglutination test was positive, 1:16, and follow-up x-ray examination showed some clearing of the chest lesion (fig. 2).

In this case there was also a history of contact with cattle infected with Bang's disease eight years previously.

Case 6. A white man, aged 42, came to Cleveland Clinic April 26, 1932, with a draining sinus of the right anterior chest wall of seven months' duration. He had acquired Malta fever as a foreign missionary in May, 1931, and at the same time developed a painful area in the right side of the chest. Some peculiar changes in the lungs from the time of the original infection were reported. A large abscess had developed in the right buttock in August, 1931, had been drained, and had healed.

He now had no cough, a good appetite, and was gaining in weight. Temperature was normal, pulse 100. There was a sinus opening with excess granulation tissue between the right fifth and sixth ribs medial to the midclavicular line, and a few scattered rales



a *b*

FIG. 3. Case 6. (a) Nodular granulomas in both lungs (9-6-32) with (b) residual scarring (10-1-34).

were present in both lungs, though most numerous at the right apex. The thyroid was diffusely enlarged, and a nodule 1 cm. in diameter was present in the epididymis above the left testicle. The brucellosis agglutination test was positive, 1:640. A chest film showed a linear density between the right mid and upper lobes and several discrete, round nodules of homogenous density, approximately 2 cm. in diameter, lying between the second and third interspaces. The left lung contained a similar nodule 4 cm. in

diameter (fig. 3). All of these had the appearance of metastatic malignant disease. Cultures from the sinus yielded Staphylococcus aureus. The patient was treated with iodides, bacteriophage, and neoarsphenamine. On June 5, 1933, the nodules were smaller and less dense, and by October 1, 1934, nothing remained but residual scarring. Meanwhile the sinus in the chest wall had healed, but another abscess developed in the right gluteal region and was incised. Culture revealed a gram-positive bacillus. Healing took place after several months. Other superficial infections appeared in the left parieto-occipital region and upper portion of the left thigh in 1933 and 1934 and healed after several months' drainage. Chest films were again negative in 1936, and the blood agglutination varied from negative to 1:40. A communication received in 1938 reported that the patient had remained in good health

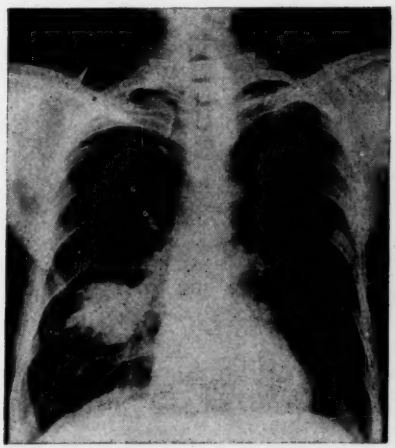


FIG. 4. Case 7. Large granulomatous infiltration in right lung.

Case 7. A white man, aged 48, came to Cleveland Clinic Hospital July 17, 1946, because of pain in the left flank and fever of one month's duration. He also had a slight, hacking, nonproductive cough. There had been some increased frequency of urination and pyuria at the onset. He had received courses of sulphonamides and penicillin without benefit. His previous examination had revealed an afternoon temperature of 100° to 101°, a positive brucellosis agglutination, 1:360, and a strongly positive intradermal test. Urologic studies were negative. There was a history of recent use of raw milk. A chest film had revealed a large, solitary, nodular infiltration extending 6 cm. from the lower portion of the right hilus into the lower anterior aspect of the right lung (fig. 4). Little additional information of a positive nature was gained during a two-week period of observation. There was no evidence of neoplasm by bronchoscopic examination, and cultures were negative. This patient was known to have had a negative chest x-ray examination three years prior to his present illness.

Discussion

Chronic brucellosis may be difficult to diagnose. Often the diagnosis has to be made on the clinical characteristics, the exclusion of other

disease, and a positive skin test. We have not made a diagnosis on a positive skin test alone. We feel reasonably certain that the diagnosis is correct in the cases cited, although the causative organism has not been recovered in any patient.

Case 1 is presented as an example of a common type of pulmonary localization that is more apt to occur in the acute variety of brucellosis and does not exhibit any changes on x-ray examination. The laryngitis in case 2 was pronounced. Hilar and bronchovascular infiltration is characteristic of the most common type of pulmonary pathology reported in this disease. Pleurisy and pleural effusion, as illustrated by case 3, are apparently uncommon manifestations, but brucellosis undoubtedly should be considered more often in cases of pleural effusion when acid-fast infection cannot be demonstrated. In case 4 the lung abscess was merely another step in the adverse progress of the disease.

Case 5 probably represents an unresolved pneumonic process. Cases 6 and 7 are believed to represent pulmonary granulomas and are like nothing else reported in the literature of brucellosis. They could easily be confused with neoplasms, and only the course of the disease can rule this out. In case 7 a benign course remains to be demonstrated.

Among 227 case records of brucellosis which we have recently reviewed, x-ray evidence of hilar and peribronchial infiltration was present in 10 additional cases, cough was recorded as a prominent symptom in 28, a respiratory infection marked the onset in 7, recurrent respiratory infection was present in 19, and hemoptysis was recorded in 4 cases.

Conclusion

Brucellosis may be easily overlooked as the cause of pulmonary disease.

The pulmonary tract is frequently affected in brucellosis, hence this disease should always be considered when otherwise unexplained disease of the bronchi, lungs, or pleura is present.

Seven patients who illustrate different phases of pulmonary disease due to brucellosis are reported.

References

1. Marston, J. A.: Report on fever (Malta). Cited by Huddleson, I. F.: Brucellosis in Man and Animals. (New York: The Commonwealth Fund, 1939) p. 64.
2. Craig, C. F.: Symptomatology and diagnosis of Malta fever with report of additional cases. Internat. Clin., Series 15, **57**:730. 1906.
3. Hughes, M. L.: Mediterranean, Malta or Undulant Fever. (New York: Macmillan and Company, 1897).
4. Bogart, F. B.: Pulmonary changes in undulant fever. South. M. J. **29**:1-9 (Jan.) 1936.
5. Beatty, O. A.: Manifestations of undulant fever in respiratory tract. Am. Rev. Tuberc. **36**:283-289 (Aug.) 1937.
6. Harris, H. J.: Brucellosis (Undulant Fever): Clinical and Subclinical. (New York: Paul B. Hoeber, 1941).

7. Althoff, H., and Rating, B.: Ueber lungenveranderungen beim morbus Bang. Klin. Wehnschr. 22:597 (Sept. 18) 1943.
8. Elsom, K. A., and Ingelfinger, F. J.: Eosinophilia and pneumonitis in chronic brucellosis; report of two cases. Ann. Int. Med. 16:995-1002 (May) 1942.
9. Huddleson, I. F.: Brucellosis in Man and Animals. (New York: The Commonwealth Fund, 1939).
10. Johnson, R. M.: Pneumonia in undulant fever; report of 3 cases. Am. J. M. Sc. 189:483-486 (April) 1935.
11. Lafferty, R. H., and Phillips, C. C.: Pulmonary changes in patients suffering from Malta fever. South. M. J. 30:595-600 (June) 1937.
12. Menefee, E. E., and Poston, M. A.: Chronic brucellosis of twenty-five months' duration. South. M. J. 31:1061-1062 (Oct.) 1938.
13. Shipley, F. M.: Pulmonary manifestations of brucellosis. Bull. School Med. Univ. Maryland 30:80-83 (Oct.) 1945.
14. Haden, R. L.: Treatment of undulant fever with sulphanilamide; report of a case. Cleveland Clin. Quart. 5:241-242 (Oct.) 1938.

CLINICAL OBSERVATIONS ON THE MECHANISM OF HYPERTENSIVE HEADACHE AND THE RESULTS OF ITS TREATMENT WITH DIHYDROERGOTAMINE TARTRATE

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Suggestive evidence indicates that hypertensive headaches are in some respects similar to migraine (Janeway[1]) and may be due to dilatation and distention of branches of the external carotid rather than intracranial arteries (Schumacher and Wolff[2]). As reported by Steiner,[3] migraine can often be relieved by vasoconstriction and the resultant decreased amplitude of arterial pulsation induced by ergotamine tartrate. However, this drug is not without unpleasant side effects such as nausea and vomiting. Although it has also been shown to elevate the blood pressure of human beings, the elevation is not of great magnitude, since Pool, von Storch, and Lennox[4] showed that subjects who were given injections of 0.5 mg. intravenously had an average rise of only 13 mm. Hg in both systolic and diastolic pressure.

Recently, dihydroergotamine tartrate has been made available for clinical trial and is believed to be less toxic than the parent drug. The

Cleveland Clinic Research Division tested its value in the control of headache associated with hypertension by giving doses of 1 mg. by subcutaneous injections to 13 patients who exhibited headache. A total of forty such injections was administered. To determine the effect of dihydroergotamine tartrate upon blood pressure 1 mg. was given by subcutaneous injection to 5 hypertensive persons. The blood pressure was measured every fifteen minutes for two hours.

In order to explore further the similarity of hypertensive headache to migraine headache, the effects of pressure on the external carotid artery and its palpable branches were tested in 6 patients with headache.

Results

Two patients had relief for one hour following the first dose. However, not only did they receive no relief from subsequent injections, but 1 complained of more severe headache after the second and nausea after the third; the other experienced diminishing relief with added nausea after the sixth injection. Two patients noted some improvement following the first treatment but later experienced nausea, and 1 vomited.

Seven of the 13 patients were nauseated by the drug, 6 vomited, and 1 complained of substernal oppression on two occasions. Five refused further injections.

None of the 5 hypertensive persons whose blood pressure was measured repeatedly following injection of dihydroergotamine showed any change in blood pressure during the two hours they were observed.

Of the 6 subjects in whom an effort was made to abolish pain by compression of the external carotid arteries or their palpable branches, none was relieved, regardless of the combinations of vessels temporarily occluded.

Discussion

Fay[5] demonstrated that stimulation of many extracranial and intracranial arteries and distention of venous sinuses produced headache. Sutherland and Wolff[6] and Ray and Wolff[7] corroborated this finding and, in addition, induced headache by traction on arteries at the base of the brain, traction on meningeal arteries, irritation of dura mater over the floor of the skull, and direct pressure on cranial nerves containing afferent pain fibers.[8] All of these procedures were capable of producing secondary contraction of the skeletal muscles of the neck and scalp, which was itself painful. The latter is a complaint common among hypertensives.

Sutherland and Wolff[6] and Schumacher and Wolff[2] showed that dilatation of cranial arteries and the accompanying increased amplitude of pulsation were responsible for headache associated with fever, injection of histamine, and migraine. Measures which decreased the amplitude of pulsation in extracranial arteries, such as injection of ergotamine tartrate[9,10] and pressure on the carotid artery, relieved the headache of migraine but not that of fever or histamine injection.

Headaches of hypertension are inconstant. Pain may be unilateral or bilateral, occipital, frontal, retro-orbital or parietal, may radiate downward to the neck and shoulders, or may be any combination of these.

Robey[11] found that only half of 448 hypertensives complained of headaches and that neither the arterial nor cerebrospinal fluid pressure bore any relation to their incidence or severity.

Janeway[1] in 1913 presented clinical evidence indicating similarity between hypertensive and migrainous headache. Sutherland and Wolff[6] have stated that in some patients with hypertensive headaches there is a cerebral vasodilatation comparable with that observed in migraine and have reported complete relief of pain for three months in 1 patient who underwent an operation for ligation of the temporal arteries. However, contrary to the results reported in migraine, none of our patients was relieved by pressure on extracranial arteries.

Although successful treatment of hypertensive headache with ergotamine tartrate has been reported by Steiner,[3] only 2 patients of our group had any relief from pain following injection of dihydroergotamine tartrate, a drug which can be expected to have the same activity as its parent. The other 11 obtained no improvement, and 8 experienced some nausea or vomiting. One patient twice complained of substernal oppression. Five refused further treatment with the drug.

Summary

The mechanism of migrainous headache, which is believed to include dilatation of extracranial vessels and increased amplitude of pulsation, appears to differ from that of the usual hypertensive headache. Compression of extracranial arteries or injection of dihydroergotamine tartrate, which relieve most migraine headaches, did not abolish the hypertensive headaches.

Dihydroergotamine tartrate administration is not useful in the treatment of hypertensive headache, as judged by the careful study of 13 hypertensive patients with severe headaches.

We are grateful to the Sandoz Chemical Company for the dihydroergotamine tartrate used in these experiments.

Results of Treatment of Hypertensive Headache with Dihydroergotamine Tartrate

Patient	Blood Pressure	Number of Injections	Results Obtained from Injections					
			Relief	Headache Exaggerated	Nausea	Vomiting	Substernal Pain	Refused Medication
1.	200/130	1 2	++++	√	√	√		
2.	190/130	1 2 3 4 5	+++ ++ 0 0 0					 √
3.	140/100	1 2 3	0 0 0	√ √ √				
4.	250/150	1 2 3	0 0 0		√ √	√ √		√ √
5.	220/130	1 2	+ 0		√	√		
6.	172/112	1 2	0 0		√ √	√ √	√ √	 √
7.	210/130	1 2	0 0		√	√		√
8.	210/130	1 2 3 4	0 0 0 0					
9.	150/100	1 2	0 0					
10.	210/100	1 2	0 0					

Results of Treatment of Hypertensive Headache with Dihydroergotamine Tartrate

Patient	Blood Pressure	Number of Injections	Results Obtained from Injections					
			Relief	Headache Exaggerated	Nausea	Vomiting	Substernal Pain	Refused Medication
11.	170/95	1	++++					
		2	++		√			
		3	++					
		4	0					
		5	0					
12.	200/120	1	0					
		2	0		√	√		
13.	180/100	1	0					
		2	0					
		3	0					
		4	0					
		5	0					
		6	0					

References

1. Janeway, T. C.: Nephritic hypertension; clinical and experimental studies. N. York M. J. **97**:400-402. 1913.
2. Schumacher, G. A., and Wolff, H. G.: Experimental studies on headache; contrast of histamine headache with headache of migraine and that associated with hypertension; contrast of vascular mechanisms in preheadache and in headache phenomena of migraine. Arch. Neurol. & Psychiat. **45**:199-214 (Feb.) 1941.
3. Steiner, S. A.: The typical headache of essential hypertension. Med. Ann. District Columbia **14**:531-538 (Dec.) 1945.
4. Pool, J. L., von Storch, T. J. C., and Lennox, W. G.: Effect of ergotamine tartrate on pressure of cerebrospinal fluid and blood during migraine headache. Arch. Int. Med. **57**:32-45 (Jan.) 1936.
5. Fay, T.: Mechanism of headache. Tr. Am. Neurol. A. **62**:74-77. 1936.
6. Sutherland, A. M., and Wolff, H. G.: Experimental studies on headache; further analysis of mechanism of headache in migraine, hypertension and fever. Arch. Neurol. & Psychiat. **44**:929-949 (Nov.) 1940.
7. Ray, B. S., and Wolff, H. G.: Experimental studies on headache; pain-sensitive structures of head and their significance in headache. Arch. Surg. **41**:813-856 (Oct.) 1940.
8. Wolff, H. G.: Headache and cranial arteries. Tr. A. Am. Physicians **53**:193-198. 1938.
9. Goodman, L., and Gilman, A.: The Pharmacological Basis of Therapeutics. (New York: Macmillan Co., 1941).
10. Lennox, W. G., von Storch, T. J. C., and Solomon, P.: Effect of ergotamine tartrate on non-migrainous headaches. Am. J. Sc. **192**:57-61 (July) 1936.
11. Robey, W. H.: Headache. (Philadelphia: J. B. Lippincott Co., 1931).

PROPYL THIOURACIL IN THE TREATMENT OF HYPERTHYROIDISM

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The medical treatment of hyperthyroidism is much more satisfactory today than it was even such a short time ago as the early part of this year. A year ago thiouracil had already been proved capable of controlling all types of hyperthyroidism, whether associated with Graves' disease or with adenomatous goiter, except when crisis was present or impending. It was used with outstanding success in the preoperative preparation of severely ill patients and those in whom complete control of hyperthyroidism before operation was an especial advantage. It was used successfully in many cases as the sole method of treatment.

There were two great obstacles to the general use of thiouracil. The first was the risk of severe agranulocytosis, known to occur in as many as 3 per cent of the patients and fatal in perhaps half of these. This was comparable to the surgical mortality in good hands and might have been an acceptable risk except for the second obstacle. This was our lack of knowledge as to the rate of recurrence of the disease after the withdrawal of treatment. It is this fact which still tips the balance slightly in favor of surgery in many patients, since the rate of recurrence of hyperthyroidism following subtotal thyroidectomy competently done is probably not more than 5 per cent in Graves' disease and much lower in adenomatous goiter.

For reasons such as these it has been our policy to recommend thiouracil only for those patients in whom the risk of surgery or complications was high, and for those patients whose safety was definitely increased by its use. Iodine preparation and thyroidectomy was considered the treatment of choice in all patients in whom the surgical risk was obviously very slight. By these means the surgical mortality of the disease was reduced almost to the vanishing point.

The problems peculiar to adenomatous goiter are clearly problems for the surgeon, whenever the issue is one of cosmetics, pressure, or the possibility of malignant change. The advisability of the use of the thiourea compounds is therefore more distinct in the diffuse gland than in adenomatous goiter, the diffuse goiter having no potential risk of enlarging greatly or becoming malignant.

The slowness of the action of the thioureas obviously renders them entirely unsuitable for the management of crises. Here iodine, sedation,

refrigeration, oxygen, blood, and all the adjuvant measures so well established must be employed.

In some of the seriously ill patients who were denied surgery and treated with thiouracil, operation was later considered advisable. Reasons for this included the following: (1) tendency to recurrence of the disease, (2) presence of pressure symptoms, and (3) the possibility of malignancy. In some severely ill patients when the hyperthyroidism had been completely controlled, clinical improvement was so great as to make surgery appear unnecessary. Some of these individuals were continued on thiouracil for many months and now have remained in remission following cessation of treatment for periods extending to a year and a half or more.

The use of propyl thiouracil has almost completely removed the objection raised against thiouracil because of toxic reactions. Astwood,[1] who proposed the use of this drug, recently reported its use in 100 cases of hyperthyroidism without a single toxic reaction of note. Among more than 500 patients who have been treated with propyl thiouracil in various parts of the country we are aware of only 1 instance of agranulocytosis.[2] This person may have had agranulocytosis on previous occasions. Recovery followed the generous use of penicillin.

We have now used propyl thiouracil in the management of 110 patients with hyperthyroidism. Among these are 4 who had had toxic reactions to thiouracil sufficiently severe to prevent its use. One woman could not take thiouracil or thiobarbital because of fever, nausea, and a fall in neutrophil count, but propyl thiouracil produced no untoward effects and controlled her hyperthyroidism completely. In only 1 of our patients has propyl thiouracil been discontinued. In this instance mild sore throat and a fall in leukocyte count followed repeated trials. Finally, the neutrophils fell to 22 per cent, and this, plus the anxiety incident to it, was considered sufficient reason to abandon the treatment in favor of iodine and surgery.

It is much too early to know what the rate of recurrence will be after the drug has been stopped. In our patients the duration of treatment varies from one week to eight months. Our present plan is to continue the drug for six to nine months after the metabolic rate has become normal. It is not too early, however, to state that the drug is an effective means of controlling the hyperthyroidism of Graves' disease as well as that associated with adenomatous goiter.

Symptoms and complications both disappear under its effect, just as with any other method which controls the hyperthyroidism completely. The response closely parallels the drop in basal metabolic rate, although in severely ill patients, old people, or any who have been severely ill for a long time, many months may be necessary for complete recovery.

In most instances a great advantage to treatment with propyl thiouracil is that almost all patients can remain ambulatory throughout their entire treatment, and most of them can continue with their usual employment. Even those with metabolic rates 50 per cent above normal may be able to maintain their weight while working when a high caloric intake is properly arranged. In some, sedation or extra rest is useful, and in those with cardiac decompensation, digitalis alone or coupled with sufficient rest and other means to relieve cardiac strain and edema may be necessary.

Propyl thiouracil, therefore, is a safe and effective method of treatment. It obviates in almost all patients the expenses incident to work loss, hospital, and surgical expenses. In addition, such complications as recurrent nerve injury or parathyroid tetany need not be considered. Up to the present there appears to be no tendency to hypothyroidism, and in no instance observed has exophthalmos become worse or the goiter increased materially in size. In some patients a striking thrill and bruit appear in the gland during therapy, but these disappear promptly on 10 mg. of iodine per day with no loss of effectiveness in control of the hyperthyroidism.

The rate of response to propyl thiouracil at proper dose levels apparently differs little from that seen with thiouracil. In this respect it should be recalled that there was an extremely wide variation in the rate of response to thiouracil. In some patients treated with this drug the

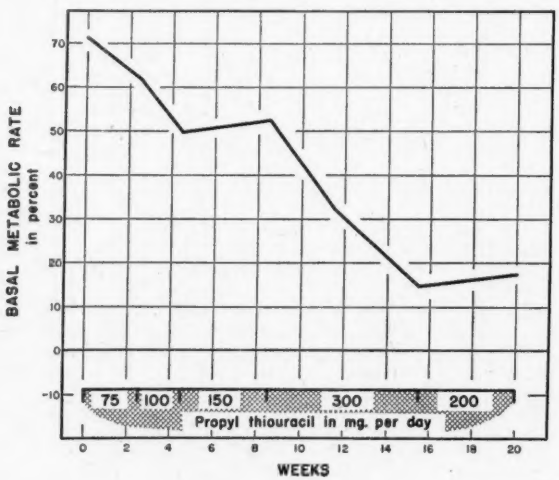

Chart 1.

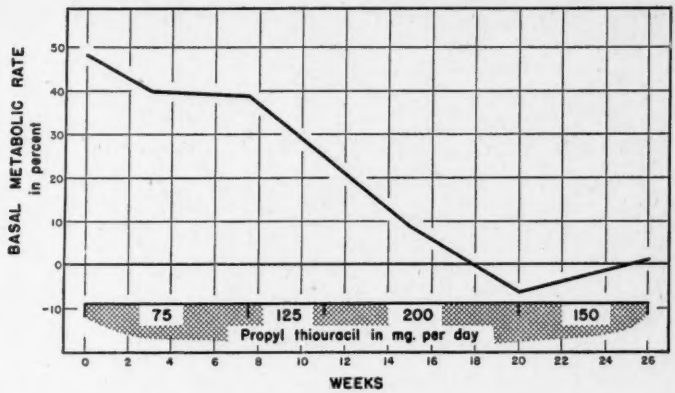

CHART 2.

metabolic rate fell more than 1 per cent per day, while in others no response was evident for many months. As with thiouracil, the response to propyl thiouracil is most dramatic in Graves' disease which is of short duration, when the thyroid gland is small, and in which no previous iodine therapy has been applied. Whether or not the combined use of iodine and propyl thiouracil may combine speed of response (iodine) with safety of prolonged control (propyl thiouracil) is a problem now being explored.

The size of the dose is a large factor in the rate of response to the drug. Until a few months ago the dose was raised above 100 mg. per day only with caution. It was soon learned that unless the symptoms and metabolic rate responded promptly, doses of 200 mg. or 300 mg. per day might bring about much more rapid recovery (chart 1). In many of our patients who were started on doses of 75 mg. per day and increased gradually, a fall of 50 per cent in metabolic rate in about three months was common (chart 2). In others, even in the presence of extremely active Graves' disease, the response may be more rapid (chart 3). At present the usual dose in starting treatment is 200 mg. per day given in divided doses.

Summary

Experience with the use of propyl thiouracil in the treatment of 110 patients with hyperthyroidism during the past eight months has led us to consider it a safe and effective means of treatment except in crisis.

If future experience establishes the fact that the rate of recurrence of hyperthyroidism is low following such therapy, or if the prolonged

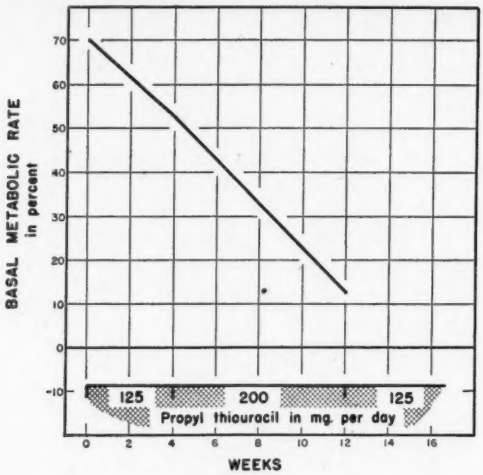

Chart 3.

use of the drug is practicable, propyl thiouracil bids well to become the treatment of choice, particularly in the hyperthyroidism of Graves' disease.

Hyperthyroidism associated with adenomatous goiter can be controlled by propyl thiouracil. The cosmetic aspects of the problem as well as pressure symptoms and possibility of malignancy remain. These require careful evaluation and should influence the decision as to the type of treatment prescribed for these patients.

References

1. Astwood, E. B.: Use of Thiouracil in Hyperthyroidism. Paper read at twenty-seventh annual session of American College of Physicians, May 13-17, 1946.
2. Bartels, E.: Personal communication.

TREATMENT OF THROMBOANGITIS OBLITERANS BY ROENTGEN THERAPY

Report of a Case

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Good results have followed sympathectomy for thromboangitis obliterans in selected cases. Many reports concerning improvement after roentgen therapy appear in the literature. These reports were reviewed recently by Pfahler,[1] who discussed clinical signs and symptoms and various technics that have been employed for irradiation. He stated that his patients and others so treated had been benefited. Those patients in whom irradiation was directed along the spinal column to the sympathetics were improved, whereas those treated locally to the extremities were not.

There may be remissions of a few months or years during the course of the disease, although complete relief of symptoms and disappearance of signs for long periods probably would not take place spontaneously without treatment. The case being reported is of interest because the patient has been free of symptoms for thirteen years following treatment, and it may be justifiable to consider roentgen therapy responsible.

Case Report

A man, aged 37, of Armenian-Jewish ancestry, was first examined by Dr. W. James Gardner at Cleveland Clinic in December, 1932. He complained of pain in his feet which had become progressively worse during the past five years. Three weeks prior to admission the medial surface of the left foot had become purple. He was no longer able to work because his job required that he stand all day. Walking even for ten minutes caused severe aching and numbness of both feet, which at times became swollen and dark red. Exposure to cold and dependent position aggravated the distress, while heat and elevation provided relief.

The patient knew of no one in his family having a similar condition. Except for his present trouble he had always been in good health and was the father of five healthy children. He had not used rye bread or coffee in excess, but he smoked at least twenty cigarettes a day.

There was nothing significant in the physical examination except that relevant to the legs and feet. Blood pressure, pulse pressure, and temperature were normal, as were laboratory and x-ray examinations. However, blood Wassermann test was 4+ on one occasion.

Both feet were swollen and discolored dark reddish purple over an area which extended just above the ankles, with the skin glistening and tense. This condition was more

apparent in the left foot. No pulsations could be elicited in the dorsalis pedis or posttibial arteries but were palpable in the popliteals and femorals.

Temperature recordings of the skin were made before and after spinal anesthesia. A thermocouple was placed on both big toes, middle phalanges of both hands, and chest. Temperature readings of these parts were taken and 2.0 cc. of spinocain was injected to produce anesthesia to the level of the nipples.

The following temperatures were recorded:

	Before Anesthesia	After Anesthesia
Mouth	99.0	98.2
Right big toe	79.0	87.6
Left big toe	83.0	83.1
Right middle finger	89.0	89.9
Left middle finger	89.0	91.9
Chest	94.0	96.0

From this study it was concluded that there was good response in the right foot but none in the left. A diagnosis of thromboangitis obliterans was made and sympathectomy advised, but the patient refused operation. The referring physician, Dr. N. Churukian, gave antiluetic treatment.

The patient was seen four months after his original examination. The condition of the feet had progressed somewhat; the left great toe was cold, the skin black, scaly, and dry from impending gangrene. He again refused operation or to stop smoking. Roentgen therapy was recommended and given in March, 1933. Lumbar and lower abdominal portals 15 x 20 cm. were irradiated, each receiving 250 roentgens (skin dose) every fifth day for six treatments, 200 Kv. and filter equivalent to 0.8 mm. h.v.l.—copper being used.

Two months after this course of roentgen therapy there was no subjective or objective improvement, and a second course of therapy was given. At this time cervical, thoracic, and lumbar portals over the spinal column were irradiated, physical factors being as before. Each field received a total of 500 roentgens.

Two months after the second course of roentgen therapy there was definite subjective and objective improvement. The patient had little pain, the color of the feet was almost normal, and there was no swelling. However, no pulsations could be elicited in the arteries of the feet.

He was seen three years later (September, 1938), completely relieved of symptoms. The toes, which previously had been deeply discolored with incipient gangrene, were normal in appearance. The toe nails had come out spontaneously on two occasions in the meantime, and the new nails were ridged and deformed. Capillary circulation on pressure was good, and pulsations were elicited in the arteries. The temperature of feet and hands seemed to be the same on palpation. He had continued to smoke excessively and had refused to continue antiluetic treatment.

The results of roentgen therapy for this patient were recalled at a recent discussion of sympathectomy for thromboangitis obliterans, and he was asked to return for examination.

In June, 1946, thirteen years after roentgen therapy, the patient stated that he had had no further trouble, could work, and could walk several miles a day without discomfort. He had in no way changed his habits or undergone other treatment. The color of the feet was normal; the toe nails were deformed, but had not come out again; there was good capillary circulation in the toes, and pulsations were elicited in the dorsalis

pedis arteries. The patient refused spinal anesthesia, therefore without it, temperature readings were made for comparison with those made in 1932. The following results were obtained:

	1932	1946
Right big toe	79.0	91.0
Left big toe	83.0	87.0
Right middle finger	89.0	93.0
Left middle finger	89.0	93.5

It was concluded that the marked increase of skin temperatures, especially of the left foot, indicated improved circulation which was attributed to roentgen therapy administered to the sympathetics thirteen years previously.

Discussion

Apparently for many years most investigations of the etiology of thromboangitis obliterans were directed toward histologic studies of the blood vessels of the extremities. The pathologic changes have been described as including principally leukocytic infiltration and inflammation in all coats of the small arteries, with thrombosis and fibrous obliteration of the lumen.

It has been found that changes in the sympathetic ganglia are associated with alterations in blood vessels of the extremities. Craig and Kernohan[2] studied the histology of surgically removed ganglia and, among other changes associated with thromboangitis obliterans, observed proliferation of lining endothelial cells of arterioles and small arteries, thickening of the walls of larger vessels of the ganglia, no evidence of acute or chronic inflammation, and only mild edema of connective tissue. These changes were more marked in ganglia removed for thromboangitis obliterans than for other conditions.

Vasoconstrictor nonmedulated nerve fibers arise from groups of nerve cells of the lateral horns of the spinal cord from the first thoracic to the third lumbar segments. All arterioles of the body are supplied from these filaments. There is evidence that vasoconstrictor effects are the result of liberation of an adrenalin-like substance at or from the nerve endings in the arterioles. Cannon and his collaborators[3] called this substance "sympathin" and found that its formation is prevented by sympathectomy. Therefore, thromboangitis obliterans is thought to be due to a spasm of the blood vessels which results from hyperactivity of the vasoconstrictor nerves and production of sympathin. When the spasm-producing factor is present in blood vessels without advanced organic changes, sympathectomy or possible irradiation of the ganglia may be beneficial.

Although nerve tissue *per se* is resistant to irradiation, it is possible that irradiation may suppress the function of the cells which produce

sympathin. Alterations in function of some tissues (pituitary, thyroid) may follow irradiation without producing detectable histologic alterations.

It is interesting that the case being reported was not benefited by the first course of roentgen therapy directed only to the lumbar region below most of the ganglia (first thoracic to third lumbar segments) but was benefited by treatment directed along the entire spinal column, so that the entire sympathetic chain was irradiated.

Conclusion

A patient having thromboangitis obliterans has been free of symptoms and signs of the disease for thirteen years, apparently as the result of roentgen irradiation directed to the spinal sympathetic ganglia.

Roentgen therapy may be indicated for thromboangitis obliterans when operation is refused or inadvisable.

The treatment should be given along the spinal column from the first thoracic to the third lumbar segments.

References

1. Pfahler, G. E.: Roentgen therapy of thrombo-angitis obliterans (Buerger's disease). Am. J. Roentgenol. **34**:770-777 (Dec.) 1935.
2. Craig, W. M., and Kernohan, J. W.: Surgical removal and histological studies of sympathetic ganglia in Raynaud's disease, thrombo-angitis obliterans, chronic infectious arthritis, and scleroderma. Surg., Gynec. and Obst. **56**:767-778 (April) 1933.
3. Cannon, W. B., Bacq, Z. M., and Moore, R. M.: Studies on conditions of activity in endocrine organs; hormone produced by sympathetic action on smooth muscles. Am. J. Physiol. **96**:392-412 (Feb.) 1931.

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